

# NORWEGIAN COUPLES AND THE TAKE-UP OF PENSION BENEFITS

KRISTIN RASDAL



THESIS FOR THE DEGREE  
MASTER OF PHILOSOPHY IN ECONOMICS

DEPARTMENT OF ECONOMICS  
UNIVERSITY OF OSLO

MAY 2013



# Norwegian Couples and the Take-Up of Pension Benefits

---

Kristin Rasdal

© Kristin Rasdal, 2013

Norwegian Couples and the Take-Up of Pension Benefits

<http://www.duo.uio.no/>

Publisher: *Reprosentralen*, University of Oslo

## Acknowledgements

First and foremost, I would like to thank my supervisor Christian Nicolay Brinch at Statistics Norway. From the very beginning and throughout the working process he has given me excellent guidance. I am deeply grateful for his insightful comments and advices, not to mention his moral support.

I am very thankful to Statistics Norway for providing me with the data needed for the empirical analysis and for giving me the opportunity to write my thesis in an inspiring environment. I would also like to thank Ola Lotherington Vestad for reading my thesis and for his valuable comments and suggestions.

This thesis is supported through a master scholarship granted by Centre for Equality, Social Organization and Performance (ESOP) at the Department of Economics at the University of Oslo. I am very grateful to Kalle Moene, Halvor Mehlum and Johannes Elgvin for giving me the opportunity of writing my thesis for ESOP.

Finally, I wish to thank my family and friends. They have shown their support in numerous ways and have patiently listened and encouraged me throughout the working process.

Any errors or inaccuracies in this thesis are, of course, my own.



## Summary

In 2011 a comprehensive reform of the Norwegian public pension system was implemented. A key feature of the new pension scheme is the decoupling of the decision to retire from the labour force and the decision to claim old age pension benefits. Agents eligible for early pension take-up can claim pension benefits in the age range 62 - 75, regardless of whether they retire from the labour force or not. When a potential claimant delays pension take-up by, say, a year, she forgoes pension benefits this year - but annual pension benefits for the rest of her life are increased. The decision to delay claiming can therefore be thought of as buying an annuity.

Actuarial neutrality of a pension scheme requires that the expected value of future benefits is the same regardless of the timing of the pension take-up. In Norway, pensions are actuarially adjusted based on average longevity measures specific to each birth cohort. Since individual expected longevity may differ from the average longevity of a birth cohort, there is a potential scope for adverse selection. Individuals with lower than average expected longevity may increase their expected lifetime income by claiming as early as possible, while individuals with higher than average expected longevity may increase their expected lifetime income by delaying the pension take-up.

When the pension scheme was implemented in 2011, all four combinations of retirement and claiming turned out to be rather common. Brinch et al. (2013) find some positive correlation between retirement and the claiming of pension benefits, but the relationship is far from perfect. In particular, the authors find that claiming is strongly associated with predictors of expected longevity.

Individuals who retire without claiming pension benefits must rely on previous savings or some income stream to finance current consumption. Being in a couple may facilitate this option if agents can rely on the partners' income while delaying the pension take-up. This thesis investigates whether empirical evidence suggests that couples coordinate on claiming pension benefits.

This thesis relates to two strands of the economic literature: the demand for annuities and economic models of household behaviour. There is no consensus among economists on the determinants of annuity demand, nor on the extent to which the household cooperates and pool their resources. The theoretical parts of the thesis investigate both issues thoroughly.

The starting point for the empirical investigation of couples' take-up decisions

are all Norwegian citizens who were born in 1949, members of a couple and eligible for early pension take-up in 2011. For these individuals I have data on annual incomes (2010 and 2011), wealth (2010), partner's income (2010) and pension take-up. I also have data on the relative money's worth (RMW) of delaying pension take-up from age 62 to 67. In their study of adverse selection in the Norwegian pension scheme, Brinch et al. (2013) estimate a mortality model and simulate the life span of each individual in the 1949-cohort. The authors use the expected longevity to calculate the RMW of delaying pension take-up for each individual who was eligible for early pension take-up in 2011. The RMW is defined as the lifetime expected benefits conditional on claiming at age 67 in terms of expected benefits conditional on claiming at age 62.

All regression are done in Stata. The first empirical strategy is to investigate the decision to retire without claiming pension benefits. First, I estimate a linear probability model where the dependent variable is a dummy variable taking the value 1 if the individual retired without claiming pension benefits. I use own income and wealth, partner's income and the RMW of delaying pension take-up as regressors. The only significant regressor is a dummy variable indicating whether the individual is in the upper quartile of the income distribution in the sample. Importantly, wealth, partner's income and the RMW of delaying pension take-up are not significant. In the second step, I exclude individuals who did not retire from the sample, and use the same regressors to estimate the probability of not claiming pension benefits. Three regressors are significant: a dummy variable indicating whether the individual is in the upper quartile of the income distribution, a dummy variable indicating whether the individual is in the upper quartile of the wealth distribution and the RMW of delaying pension take-up. Partner's income is not significant. It is tempting to interpret the estimated result as the probability of not claiming benefits given that an individual has retired. Since the decision to retire and the decision to claim pension benefits may be simultaneous decisions, the estimated result should, however, be interpreted with caution.

The second empirical strategy is to investigate couples where both members were born in 1949 and eligible for early pension take-up in 2011. First, I estimate a linear probability model on the sample of couples where only one member claimed benefits, using the difference in RMW as the sole regressor. The difference in RMW is not significant. Thereafter I estimate the probability of wife claiming while the husband did not claim, using the RMW of delaying the take-



up of both the wife and the husband as distinct regressors. None of the regressors are significant, and we would not reject the null hypothesis that all coefficients are zero. Similarly, I estimate the probability of husband claiming while the wife did not claim, using the RMW of delaying the take-up of both the wife and the husband as distinct regressors. In this regression the RMW of delaying the husband's take-up is significant.

At last, I investigate whether empirical evidence suggests that individuals in the sample understand the incentives in the pension scheme. I estimate the probability of the wife claiming benefits, disregarding the husband's decision. I use the RMW of delaying the take-up of both the wife and the husband as distinct regressors, and find that only the RMW of delaying the wife's take-up is significant. I run a similar regression estimating the probability of the husband claiming pension benefits, regardless of what his wife did, and find that both regressors were significant. The findings suggest that claiming is strongly associated with the RMW of delaying pension take-up, and are thus in accordance with the findings of Brinch et al. (2013).

None of the empirical findings suggest that Norwegian couples coordinate on claiming pension benefits. Empirical evidence suggests, however, that the individuals understand and respond to the incentives in the pension scheme. Lack of coordination should therefore not be interpreted as lack of understanding of the incentive structure.



# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>The Norwegian Pension Scheme</b>	<b>4</b>
2.1	The Norwegian Pension System . . . . .	4
2.2	The Notion of Actuarial Neutrality . . . . .	6
2.3	Other Pensions . . . . .	9
<b>3</b>	<b>The Demand for Annuities</b>	<b>11</b>
3.1	Annuities . . . . .	12
3.2	Determinants of the Demand for Annuities . . . . .	15
3.3	Asymmetric Information and Annuity Markets . . . . .	22
<b>4</b>	<b>Economic Theory of Household Behaviour</b>	<b>26</b>
4.1	Overview . . . . .	26
4.2	Goods and Consumption in a Two-Person Household . . . . .	28
4.3	Preferences . . . . .	30
4.4	Models of Household Behaviour . . . . .	33
4.5	Existing Empirical Findings . . . . .	49
<b>5</b>	<b>Data and Empirical Findings</b>	<b>55</b>
5.1	The Data Set . . . . .	55
5.2	Retiring without Claiming Pension Benefits . . . . .	59
5.3	Both Members of the Couple from the 1949-cohort . . . . .	65
5.4	Some Concluding Remarks . . . . .	72
<b>6</b>	<b>Conclusion</b>	<b>74</b>
	<b>Appendices</b>	<b>83</b>
<b>A</b>	<b>Mathematical Calculations</b>	<b>83</b>
<b>B</b>	<b>Retiring Without Claiming Pension Benefits</b>	<b>85</b>
<b>C</b>	<b>F-test</b>	<b>86</b>
<b>D</b>	<b>Regression on a restricted sample</b>	<b>87</b>



# 1 Introduction

In 2011 a comprehensive reform of the Norwegian public pension system was implemented, specifying new rules for the accumulation of pension entitlements as well as for the claiming of old age pension benefits. The new pension scheme allows individuals to claim pension benefits at any point between age 62 and 75, regardless of whether he or she retires from the labour force. The new system allows, in other words, for a decoupling of the timing of retirement from the labour force and pension take-up. It is therefore useful to explicitly distinguish between the retirement decision and the pension take-up decision. The former refers to the decision to leave the labour force while the latter refers to the decision to claim pension benefits, and is essentially a financial decision.

The decoupling of these decisions yields four possible combinations of retirement and claiming of pension benefits. As an individual turns 62 she may choose to retire and claim pension benefits, retire and delay pension take-up, not retire and claim pension benefits, and not retire and delay pension take-up.

When a potential claimant delays pension take-up by, say, a year, she forgoes pension benefits this year - but annual pension benefits for the rest of her life are increased. The delay of claiming can therefore be thought of as buying an annuity, treating the pension benefits forfeited as the price of the annuity. Actuarial neutrality of a pension scheme requires that the net present value of future benefits is the same regardless of the timing of the pension take-up. In Norway, pensions are actuarially adjusted based on average longevity measures specific to each birth cohort. Since individual expected longevity may differ from the average longevity of a birth cohort, there is a potential scope for adverse selection. Individuals with lower than average expected longevity may increase their lifetime pension income by claiming as early as possible, while the opposite holds for individuals with higher than average expected longevity.

The findings of Brinch et al. (2013) suggest that there is substantial adverse selection with regard to the claiming of pension benefits in the new Norwegian pension scheme. The authors find some positive correlation between retirement and the claiming of old age pensions, but the relationship is far from perfect and all four combinations of retirement and claiming are rather common. This means that many individuals claim pension benefits without retiring and that many individuals retire without claiming old-age pension benefits. The decision to retire from the labour force and the decision to claim pension benefits are

clearly decoupled for a significant number of individuals, and Brinch et al. (2013) find that claiming is strongly associated with predictors of expected longevity.

In this thesis I will investigate whether empirical evidence suggests that Norwegian couples coordinate on claiming pension benefits. Individuals who retire without claiming pension benefits need to rely on previous savings or some income stream to finance current consumption. Being in a couple may facilitate this option if an agent can rely on the partner's income while delaying the take-up. Economic models of the household differ, however, in their predictions of economic cooperation and household money management.

The topic of this thesis relates to two strands of economic theory. Since delaying the take-up of pension benefits is equivalent to buying an annuity, the take-up decision can be analyzed in the theoretical framework normally used to study the demand for annuities. The second component of the the theoretical framework is economic models of household behaviour.

The rest of this thesis is organized as follows. Chapter 2 provides a brief overview of the new Norwegian pension scheme, as well as an explanation of how the pension scheme is actuarial neutral on average. Emphasis is also put on how expected longevity at the moment of take-up determines annual pension benefits.

Chapter 3 discusses the demand for annuities. The first section explains what annuities are and how their money's worth is calculated. The second section discusses several determinants of annuity demand, while the third section stresses problems of asymmetric information, and adverse selection in particular. Lastly, I will refer to some empirical findings on adverse selection in annuity markets.

In chapter 4 I complete the theoretical framework of the thesis by introducing four economic models of household behaviour. The second section emphasizes the distinction between private and public goods in the household, while three broad types of preferences and their properties are presented in the third section. Basically, there are four broad options for modelling household behaviour: the unitary approach, non-cooperative models, collective models and bargaining models (Browning and Lechene, 2001). In the fourth section I present models of household behaviour from each strand, and discuss their predictions with regard to couples' pension take-up. The fifth section provides an overview of some empirical findings to which this thesis relates.

All regressions are done in Stata, and the empirical results are reported in chapter 5. The first section of the chapter provides a description of the data set that I will use for the empirical analysis: all Norwegian citizens who became

eligible for early pension take-up in 2011 by turning 62 years. I will also explain how Brinch et al. (2013) estimate expected longevities for the Norwegian cohort of 1949 within the framework of the microsimulation model MOSART, and how the authors use these estimates to calculate the *relative money's worth* (RMW) of delaying pension take-up from age 62 to 67 for each individual. The first empirical strategy is to investigate how own income and wealth, the RMW of delaying pension take-up and partner's income can explain the choice to retire without claiming pension benefits. The second section of the chapter describes this empirical strategy, reports the regression results and discusses the findings. The second empirical strategy is to investigate the pension take-up by couples where both members were born in 1949 and were eligible for pension take-up in 2011. I use the RMWs of delaying pension take-up of both members in two different ways to estimate the probability of only one member claiming benefits. The third section describes the second empirical strategy, reports the regression results and discusses the findings. As last, I investigate whether empirical evidence suggests that the individuals in the sample understand the incentive structure in the pension scheme and behave in accordance with the findings of Brinch et al. (2013).

Chapter 6 concludes.

## 2 The Norwegian Pension Scheme

The aim of this chapter is to describe the pension scheme that was implemented in Norway in January 2011. A key feature of the new pension scheme is flexible retirement for the age group 62 - 75 years. Flexible retirement rules imply that the decision to retire from the labour force and the decision to claim old age pension benefits are in principle decoupled. In particular, the latter decision is essentially a purely financial decision.

This chapter is organized as follows: the first section provides a brief overview of the rules for accumulation of pension entitlements as well as the rules for pension take-up. I will describe both the post-reform rules for the accumulation of pension entitlements as well as the pre-reform rules.<sup>1</sup> In the second section I will explain the concept of actuarial neutrality and how the Norwegian pension scheme is actuarial neutral on average. I will also explain how life expectancy at the moment of pension take-up is an important determinant of the level of annual pension benefits. In the third section I will briefly describe contractual pensions in the private and public sector, as well as spouse benefits and surviving spouse benefits.

### 2.1 The Norwegian Pension System

#### The Accumulation of Pension Entitlements

The new pension scheme consists of an income pension and a guarantee pension for people with no or only a small income pension.

With regard to the income pension the notion of pension wealth is an important feature. At any point in time, a person's pension wealth is the sum of the pension entitlements that he or she has accumulated.<sup>2</sup>

A feature of the new Norwegian pension scheme is that all income made from the age of 13 until the age of 75 increases pension wealth. This means that all years with income count equally, and it is referred to as "the all-years-rule". There is an upper bound to an individual's yearly accumulation of pension

---

<sup>1</sup>In the empirical part of this thesis I will use data on the Norwegian 1949-cohort. Since these individuals have accumulated their pension entitlements according to the pre-reform rules, I found it useful to describe these rules as well.

<sup>2</sup>The Norwegian pension system is a "pay as you go" system, and the pension wealth is only a fictitious or virtual capital account.



entitlements, corresponding to 18.1% of 7.1 basic amounts.<sup>3</sup> Pension entitlements are accumulated through income from work, but also through serving compulsory military service, receiving unemployment or sick leave benefits or doing unpaid care work. Throughout the contribution period there is full wage indexation, which means that the pension wealth is adjusted in line with the economy-wide wage growth every year until the pension benefits are claimed.<sup>4</sup>

The pension benefits in the previous pension scheme were based on a two-tier system: a basic pension and a supplementary pension. A person's basic pension was determined by the length of the membership in the National Insurance Scheme, and was approximately equal to the basic amount. If a person was married or living as a cohabitant, the partner's income status would also determine the basic pension. The supplementary pension was, on the other hand, dependent on earnings over the life-cycle.<sup>5</sup> Individuals accumulated "pension points" in the age range of 17 - 69, and full supplementary pensions were earned after 40 years ("the 40 years rules"). The main determinant of the supplementary pension was an adjusted average point score, which was calculated on the basis of the individual's 20 best years, i.e. the 20 years where income was highest relative to the basic amount.

The new rules for accumulation of pension entitlements are binding for all cohorts born after 1963. For cohorts born in the period 1954 - 1962 the new rules for accumulation of pension entitlements are combined with the old rules. For cohorts born before 1953 pension entitlements are accumulated as specified by the old pension scheme.

### **Flexible Retirement Age and Take-Up Rules**

Until 2011, old age pensions benefits from the National Insurance Scheme could be claimed only as a person turned 67. The new pension scheme, however, allows an individual to claim old age pension benefits at any point between age 62 and 75, regardless of whether he retires from the labour force or not. This makes it necessary to distinguish between the decision to retire from the labour force and the decision to claim old-age pension benefits. I will refer to the former as the retirement decision and to the latter as the take-up decision.

---

<sup>3</sup>The basic amount (G) was in May 2012 specified such that  $1\text{ G} = 82\,122\text{ NOK}$ , and  $7.1\text{ G} = 583\,066\text{ NOK}$ .

<sup>4</sup>For further details see Arbeidsdepartementet (2009).

<sup>5</sup>Persons with very low earnings got a special supplementary pension, such that  $\text{minimum pension} = \text{basic pension} + \text{special supplementary pension}$ .

A person can also choose whether to draw the entire pension or only a fraction of it.<sup>6</sup> There is no means testing, which means that the pension income is neutral towards other income streams. In this way, the new rules facilitate the combination of pension and labour income, and an individual can work as much as he wants without his pension benefits being reduced. If an individual does not retire from the labour force as he decides to claim his pension benefits, he will continue to earn pension entitlements.

In Norway, pension benefits are paid until a person deceases. By delaying the take-up of pension benefits, the annual payments that an agent receive for the rest of his life will increase. Depending on expected longevity, there may thus be substantial gains to delaying the old age pension benefits. This possibility will thoroughly be explored below.

Not everyone is eligible to claim old age benefits before the age of 67. In order to be eligible, the accumulated pension entitlements must be sufficiently high. More precisely, for an individual to be eligible for early pension take-up, his accumulated pension wealth must be high enough to ensure that he will, at the age of 67, receive yearly pension benefits equal to or greater than the minimum pension.<sup>7</sup>

## 2.2 The Notion of Actuarial Neutrality

The notion of actuarial neutrality is an important feature of the new Norwegian pension scheme. In this section I will explain the meaning of actuarial neutrality and how the Norwegian pension system is actuarial neutral on average. I will thereafter explain how a life expectancy adjustment ratio is used to adjust annual pensions.

### The Actuarial Neutrality of the Norwegian Pension Scheme

In many countries the decision to retire from the labour force and the decision to claim old age pension benefits are essentially the same decision. These decisions

---

<sup>6</sup>The fractions among which an individual can choose are 20%, 40%, 50%, 60%, and 80%.

<sup>7</sup>If the yearly pension benefits and the minimum pension level were regulated according to the same principles, a necessary and sufficient condition would be that the yearly pension benefits at the moment of the claiming were tangent to the minimum pension level. The regulation of yearly pension benefits is, however, different than the regulation of the minimum pension. As a consequence, the yearly pension benefits at the moment of claiming must be strictly greater than the minimum pension level for 67 year-olds at the moment of claiming. For further details see Arbeids- og velferdsdirektoratet (2011).

are decoupled in Norway, and the latter is essentially a financial decision. Actuarial neutrality of the Norwegian pension scheme means that for a given pension wealth, the net present discounted value of future benefits is independent of the timing of pension take-up (Jousten, 2007; Queisser and Whitehouse, 2006).

The notion of actuarial neutrality can be illustrated by the following example. An individual who is eligible to claim old age pension benefits when she turns 62 faces the following trade-off: she may claim her benefits now, or she may delay claiming by, say, a year. The delay of claiming will increase her annual payments for the rest of her life. The Norwegian pension scheme is actuarial neutral on average, meaning that for a person with average expected longevity, the reduction in annual pension benefits due to early claiming exactly offsets the longer period for which they will be received.

For agents whose life expectancy differs from the average, the expected discounted value of future pension benefits depends on the timing of the pension take-up. An agent with higher than average life expectancy, for example, will receive pension benefits for an extended period of time. This makes the increase in annual pension benefits by delaying more valuable in terms of expected discounted value of future benefits.

It is not unproblematic to claim that the Norwegian pension scheme is actuarial neutral on average. There are some practical concerns that may conflict with the pure neutrality of the take-up decision with respect to age. The assumptions about the discount rate and survival rate, for example, may not hold. Another concern is that the neutrality is defined in terms of the gross level of pensions. Pension benefits are subject to taxation, and taxation is implemented at an annual level and is progressive. Although the system is notionally neutral, the actual system is therefore not really neutral (Indahl, 2012).

### **Actuarial Neutrality and Actuarial Fairness**

Sometimes the terminology causes confusion, and economists and politicians use the term actuarial neutrality as a substitute for actuarial fairness. Actuarial fairness and actuarial neutrality are, however, two distinct concepts. A system is actuarial fair if the expected present value of benefits net of contributions over the entire life-cycle equals zero. A pension scheme that is actuarially neutral is not necessarily actuarially fair (Jousten, 2007). A feature that these two concepts have in common, is that they only make sense *ex ante*. *Ex-post* outcomes will differ because the calculation of the expected present value of accrued pen-

sion benefits is based on probabilities, but in reality people die at different ages (Queisser and Whitehouse, 2006).

### Annual Benefits and the Life Expectancy Adjustment Ratio

There are two determinants of the size of an individual's annual pension benefits: the individual's pension wealth and life expectancy at the moment of take-up. The *adjustment ratio* reflects the life expectancy, or the expected period of accrued pension benefits, at the moment of take up.<sup>8</sup> At the moment of take-up, annual pension benefits are calculated as the ratio of accumulated pension wealth to the expected longevity.

As a cohort turns 61, a set of adjustment ratios are calculated. The adjustment ratios reflect average expected longevity at different points in time for that specific cohort.<sup>9</sup> Examples of adjustment ratios are given in table 1.

Table 1: Forecast of adjustment ratios for cohorts born in 1954 - 1994 (Arbeids- og velferdsdirektoratet, 2013a).

Age	Cohort								
	1954	1959	1964	1969	1974	1979	1984	1989	1994
62	19.01	19.48	20.00	20.53	21.06	21.60	22.13	22.67	23.20
63	18.19	18.67	19.18	19.71	20.25	20.78	21.32	21.85	22.38
64	17.38	17.85	18.37	18.90	19.43	19.96	20.50	21.04	21.57
65	16.57	17.04	17.55	18.08	18.61	19.14	19.68	20.22	20.75
66	15.76	16.23	16.74	17.26	17.79	18.32	18.86	19.39	19.93
67	14.96	15.42	15.96	16.45	16.97	17.50	18.04	18.57	19.10
68	14.16	14.62	15.12	15.63	16.15	16.68	17.22	17.75	18.28
69	13.37	13.82	14.38	14.89	15.41	15.93	16.39	16.92	17.45
70	12.59	13.02	13.51	14.02	14.53	15.05	15.57	16.10	16.62
71	11.81	12.23	12.72	13.21	13.72	14.24	14.76	15.28	15.80
72	11.04	11.46	11.93	12.42	12.92	13.43	13.94	14.46	14.97
73	10.28	10.69	11.15	11.63	12.12	12.62	13.13	13.64	14.15
74	9.54	9.93	10.38	10.85	11.34	11.83	12.33	12.83	13.33
75	8.81	9.19	9.63	10.09	10.56	11.04	11.53	12.02	12.52

The introduction of life expectancy adjustment ratios in the Norwegian pen-

<sup>8</sup>The life expectancy adjustment ratio refers to a concept which is called *delingstall* or *forholdstall* in Norwegian. Both *delingstall* and *forholdstall* reflect life expectancy at the moment of take-up, but are calculated in different ways. *Delingstall* applies to the cohorts born after 1963, while *forholdstall* applies to 1943 - 1953 cohorts. For the cohorts born in 1954 - 1962 a combination of *forholdstall* and *delingstall* apply. For further details see Arbeids- og velferdsdirektoratet (2013a)

<sup>9</sup>More specifically, monthly adjustment ratios reflecting life expectancy in the age range 62 - 75 are calculated for each cohort.

sion scheme serves two main purposes. First, the use of life expectancy adjustment ratios makes the pension scheme actuarially neutral on average. Secondly, the introduction of life expectancy adjustment ratios serves to achieve financial sustainability in the longer run: when longevity increases, the pension levels will automatically be lower.

## **2.3 Other Pensions**

### **Contractual Pensions in the Private and Public Sector (AFP)**

The AFP scheme is a pension scheme for employees who have reached the age of 62 and work in an area that has a collective agreement concerning contractual early retirement. There are different rules for private and public sector contractual retirement pension schemes.

A private sector contractual early retirement pension is a lifelong supplement to the national insurance retirement pension. As an agent starts drawing his private sector contractual early retirement pension, he must also apply for the national insurance retirement pension at the same time. There is no earnings testing, meaning that the agent can work as much as he likes without the pension being reduced.

In the public sector, on the other hand, a contractual early retirement pension is an early retirement pension that can be received in the age range 62 - 67. It is not possible to receive public sector contractual early retirement pension and pension from the National Insurance Scheme at the same time. There are also restrictions on how much a person can earn without his public sector contractual early retirement pension being reduced.

### **Spouse Supplement**

Old-age pensioners who have turned 67 and receive a full pension may receive a spouse supplement. A spouse supplement can also be granted for cohabiting partners if the couple have children together or have been married in the past.

To receive a spouse supplement it is required that the spouse does not receive a national insurance pension, is not entitled to a full national insurance retirement pension, and does not have an income that exceeds the basic amount. A spouse supplement can not be granted if the spouse receives either a contractual private sector pension that was granted before 1 January 2011 or a contractual public sector pension.

## Benefits for Surviving Spouse

Survivor's pension is intended to ensure subsistence income for a surviving spouse, registered partner, or cohabitor following the death of the other party.<sup>10</sup> The pension ceases if the surviving spouse marries again or has children with a new cohabitor. Survivor's pension also ceases if a person takes out contractual pension (AFP). The pension will be converted to disability pension if the surviving party is entitled to disability pension and to retirement pension at the age of 67.

Pension and transitional benefit consist of basic pension, supplementary pension, and/or special supplement. The surviving spouse receives full basic pension if the deceased lived in Norway for 40 years.<sup>11</sup> Supplementary pension is calculated on the spouse's previous employment income and how many years he or she received employment income. Supplementary pension amount to 55 % of the supplementary pension the deceased would have received if he or she had entitlement to disability pension or retirement pension at the time of death.

The survivor's pension is means-tested and will be reduced if the surviving spouse has or can be expected to have his or her own employment income.

---

<sup>10</sup>A surviving spouse is entitled to survivor's pension if he or she was married to the deceased for at least 5 years or had a child with the deceased. A person may also be entitled to survivor's pension if he or she has custody of the child of the deceased. A surviving registered partner is entitled to benefits on the same terms and conditions as surviving spouses. The same applies to a surviving cohabitant if he or she had a child with the deceased cohabitant or had previously been married to the deceased cohabitant. For further details on the requirements for being entitled to survivor's benefits see Arbeids- og velferdsdirektoratet (2013b).

<sup>11</sup>Full basic pension is normally equivalent to the basic among (G).

### 3 The Demand for Annuities

A life annuity is a contract that pays a certain return per period to a beneficiary, the annuitant, for as long as the annuitant is alive. In Norway, a pension is a stream of benefits that is paid until the beneficiary deceases. In this context, a pension is an annuity insuring against the risk of outliving one's resources.

The decoupling of the decision to retire and the decision to claim old age pension benefits makes the latter essentially a financial decision. If an agent delays claiming by, say, a year, he increases the yearly future pension benefits through the actuarial adjustment, but forgoes pension benefits this year. The decision to delay claiming can therefore be thought of as buying an additional annuity, treating the money forfeited this year as the price of the annuity (Brinch et al., 2013). The take-up decision of old age pension benefits can therefore be analyzed in the theoretical framework normally used to study the demand for annuities. This approach has also been used by Brinch et al. (2013), Hurd et al. (2004) and Coile et al. (2002).

The aim of this chapter is to discuss some determinants of annuity demand. I will also discuss how problems of asymmetric information may lead to problems of moral hazard and adverse selection in the market for annuities. The chapter is organized as follows: in the first section I will explain what annuities are, how their money's worth is calculated and the presence of implicit annuities in the Norwegian pension scheme. The second part of the chapter provides an overview of some determinants of annuity demand. Finally, in the last section, I will explain how the market for annuities potentially is exposed to problems of moral hazard and adverse selection.

### 3.1 Annuities

An annuity is a financial product that entitles the holder to a pre-specified amount per period (e.g., every month) for as long as the annuitant is alive. Uncertain life length poses a problem of how to allocate lifetime resources when agents have no access to insurance markets. On the one hand, if they consume too conservatively, they may leave substantial unintended bequests. On the other, if they consume without caution, they run the risk of outliving their resources. Annuities provide insurance against the latter scenario (Sheshinski, 2008: 1-2).

The original meaning of "annuity" was an asset that paid an annual income without payments necessarily tied to an individual or group of individuals being alive. Traditionally, the term *life annuity* was used for an asset with life contingent payments to distinguish it from a *term-certain annuity*. A term-certain annuity is a stream of payments made for a maximum number of years, independently of survival, and is conceptually similar to conventional bonds (Cannon and Tonks, 2008: 18).

Cannon and Tonks (2008) distinguish between three generic types of single-life annuity. A *conventional annuity* pays the holder an income each period until the annuitant deceases in return for a lump sum (or premium) paid in advance. This annuity provides insurance against the risk of a long life. A *temporary annuity* is a stream of payments paid while the annuitant is alive, but with a maximum number of payments. The payment ceases either when the holder of the annuity deceases or when the maximum is reached: whichever happens first. A *deferred annuity* is a stream of payments beginning at some point in the future and made conditional on the annuitant being alive. With this type of annuity it is possible that no payments will ever be made.<sup>12</sup>

#### The Money's Worth of an Annuity

The most common way to compare the value of annuities with other assets is by using a measure called money's worth. The money's worth of an annuity is the ratio of the expected annuity payments to the price. The randomness in the income stream stems from stochastic life length. When the money's worth of an annuity is 1, the annuity is perfectly fairly priced in actuarial terms (Cannon and Tonks, 2008: 117-118).

---

<sup>12</sup>Chapter 2 in Cannon and Tonks (2008) provides a more detailed discussion of annuity product types.



The money's worth of an annuity bought at time 0 is the expected present value of the income stream divided by the price of the annuity, and is given by:

$$MW = \frac{1}{P} E \left( \sum_{t=1}^{\infty} \frac{s_t}{(1+r)^t} A_t \right) \quad (1)$$

where  $P$  is the price of the annuity,  $s_t$  is the probability of surviving year  $t$ ,  $r$  is the real interest rate and  $A_t$  is the annuity rate.

The money's worth of an annuity is increasing in the probability of surviving and decreasing in the interest rate. The first observation follows since an increase in the probability of survival implies that the expected time interval of annuity payout increases as well. The second observation follows since the net present value of an income stream is reduced when the discount factor increases. Another way to think of this, is that when the return on alternative investments increases, the opportunity cost of holding an annuity increases as well (Hurd et al., 2004).

### **Implicit Annuities in the Norwegian Pension Scheme**

The main purpose of an annuity is to insure against the risk of outliving one's resources. All participants in the Norwegian National Insurance Scheme are provided with a guarantee or minimum pension. This means that all participants are provided with an annuity and are partially isolated against this risk of outliving their resources. The take-up decision can, however, be studied within the framework normally used to study the demand for annuities. The decision to delay claiming can be thought of as buying an additional annuity, treating the money forfeited this year as the price of the annuity. In this context, the individual faces a menu of different annuities which are characterized by an agent's age at pension take-up (Brinch et al., 2013).

Let  $A_a^n$  denote the income stream at age  $a$  conditional on claiming pensions at age  $n = 62, 63, \dots, 75$ , for a given pension wealth. Delaying the claiming of old age benefits from age 62 to 67 is equivalent to buying a deferred annuity. The money's worth of this annuity is:

$$MW = \frac{E \left( \sum_{a=67}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{67} \right) - E \left( \sum_{a=67}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{62} \right)}{E \left( \sum_{a=62}^{66} \frac{s_a}{(1+r)^{a-62}} A_a^{62} \right)} \quad (2)$$

The numerator is the expected change in the stream of pension benefits by de-

laying the claiming of pension benefits from age 62 to 67. The denominator is the expected price, or the pension benefits forfeited, by delaying claiming from age 62 to 67. Note that the price is also a random variable, since an individual may decease before the pensions from age 62 to 66 are forfeited.

Actuarial neutrality requires that  $MW = 1$ . When this condition holds there are no gains by delaying the pension take-up decision. If  $MW > 1$ , delaying the take-up of pension benefits increases the expected lifetime income stream.  $MW > 1$  if and only if

$$E \left( \sum_{a=67}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{67} \right) - E \left( \sum_{a=67}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{62} \right) > E \left( \sum_{a=62}^{66} \frac{s_a}{(1+r)^{a-62}} A_a^{62} \right)$$

This is equivalent to:

$$E \left( \sum_{a=67}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{67} \right) > E \left( \sum_{a=62}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{62} \right)$$

## 3.2 Determinants of the Demand for Annuities

Theoretical research on annuities begins with Yaari (1965) and suggests there are substantial utility gains from annuitisation when the length of life is uncertain. According to Yaari (1965), risk-averse agents would be better off holding only annuitized assets in the absence of a bequest motive, or a portfolio of annuitized and traditional assets in the presence of a bequest motive. An important assumption in Yaari's contribution is that the annuity market is actuarially fair.

Although economic theory predicts substantial gains in utility from annuitization, people buy few annuities in practice. This empirical evidence is often referred to as the "annuity puzzle" (Cannon and Tonks, 2008: 180). The literature seeking to explain the puzzle has identified several factors that may reduce the demand for annuities. In this section some of these factors will be discussed.

Much of the literature on the annuity puzzle questions the assumption that annuity markets are actuarially fair. This possibility will be discussed thoroughly in the next section. For now, I will assume that there exists an actuarially fair market for annuities. Since participants of the Norwegian National Insurance Scheme have access to a market of implicit annuities that on average is actuarially neutral, this is a useful approach.

The aim of this section is to discuss determinants of the demand for annuities within the life-cycle framework. The life-cycle framework is the standard approach that economists use to analyze the intertemporal allocation of time, effort and money. In its most general form, the life-cycle model asserts that agents, throughout their lives, use currently available information and make sequential decisions to achieve a coherent goal (Browning and Crossley, 2001). Browning and Crossley (2001) emphasize the distinction between the life-cycle framework and particular life-cycle models with empirical content. The life-cycle framework, the authors argue, should be thought of as a conceptual framework within which we can develop useful models, not as one model in particular.

I have chosen to give a verbal exposition of annuity demand within the life-cycle framework instead of modelling it explicitly. The reason is the complexity of this thesis' topic, which none of the existing models for annuity demand captures in its entirety. This thesis relates to two strands of economic theory: the demand for annuities and economic models of household behaviour. Among economists there is, however, no consensus on how the demand for annuity is determined nor on the degree of cooperation in the household. Considering the scope of my thesis, the investigation of whether Norwegian couples coordinate on

claiming pension benefits, a useful approach is therefore, in my opinion, to first discuss determinants of annuity demand and thereafter some economic models of household behaviour.

Two factors, in particular, are important determinants of annuity demand. The first factor is the money's worth of the annuity. There may be substantial economic gains from buying an annuity whenever the money's worth of the annuity is higher than unity. The second factor is the agent's risk-aversion. Since annuities provide insurance they have a value above the simple money's worth to risk-averse agents. I will first explain how these two factors influence annuity demand, and subsequently discuss the importance of other factors, including pre-annuitized wealth, credit markets and liquidity constraints, the subjective discount rate, marital status and bequest motives. In the exposition I will also explain how the analysis translates in the context of the Norwegian pension scheme.

## **Financial Maximization**

Financial maximization suggests that an agent will buy an annuity if its expected income stream is greater than its cost or initial premium. In this case the money's worth of the annuity is above unity. Since the money's worth of an annuity is increasing in the survival rate, this means that the money's worth of an annuity is relatively higher for people who expect to live longer. It is therefore reasonable to assume that a person's expected longevity is an important determinant of his or her annuity demand.

It is the agent's personal beliefs about his or her own expected longevity that is important with regard to annuity demand. I will refer to the agent's beliefs about expected longevity as the subjective expected longevity or subjective survival probability. The objective life expectancy, on the other hand, is a calculation taking into account actual mortality rates and an individual's characteristics.

With regard to the Norwegian pension scheme, this means that the expected monetary value of delaying the take-up of pension benefits is higher for persons with longer than average expected longevity.

The money's worth, or similar measures, are commonly used in empirical research on annuity markets.<sup>13</sup> This framework captures one important feature: when the money's worth of an annuity is above unity, buying the annuity in-

---

<sup>13</sup>See for example Coile et al. (2002), Finkelstein and Poterba (2004) and Hurd et al. (2004).

creases the agent's expected lifetime income. Higher expected lifetime income translates into greater consumption possibilities and increases in this way expected lifetime utility.

## **Risk Aversion**

The money's worth of an annuity is simply the ratio of the expected present value of the income stream to the price of the annuity. It does not include other characteristics that may alter the value to annuitants. The most important characteristic that raises the value of annuities above the money's worth calculation, is the insurance they provide.

With regard to attitudes towards risk, agents may be divided into three categories: risk neutral, risk-averse and risk-loving. Varian (1992) uses the following example to illustrate the three attitudes towards risk: Suppose that a consumer currently has \$ 10 of wealth and is contemplating a gamble that gives him a 50 percent probability of winning \$ 5 and a 50 percent probability of losing \$ 5. His wealth will therefore be random with an expected value of \$ 10.

A risk neutral agent does not care about the riskiness of his wealth at all - only about its expected value. In this case the expected utility of wealth is the same as the utility of its expected value. For a risk-averse agent the utility of the expected value of wealth is greater than the expected utility of wealth. In other words, a risk-averse agent prefers to have the expected value of his wealth rather than facing the gamble. For a risk-loving agent the expected utility of wealth is greater than the utility of the expected value of wealth. Put differently, a risk-loving agent prefers to face the gamble rather than receiving the expected value of his wealth.

Since annuities provide insurance against the risk of outliving one's resources they have a value that is greater than the simple money's worth calculation for risk-averse agents. Let us disregard bequest motives and assume that the money's worth of an annuity is unity. When the money's worth of the annuity is unity, the expected income stream provided by the annuity is equal to the price of the annuity. A risk neutral agent is indifferent between buying the annuity or not. A risk-averse agent, on the other hand, will be strictly better off buying the annuity. An increase in the coefficient of risk-aversion should therefore lead to an increase in the demand for annuities.

In reality, and as emphasized by Sass et al. (2007), individuals who postpone the claiming of pension benefits acquire additional amounts of longevity insur-

ance. They do this on terms that are actuarially fair. In the context of the Norwegian pension scheme we would therefore expect more risk-averse individuals to be more prone to delay the pension take-up, if they consider the risk of outliving their resources a relevant risk. This is because more risk aversion leads to a higher valuation of the annuity value of delay (Coile et al., 2002).

## **Pre-Annuitized Wealth**

An annuity ensures that an individual's consumption never falls below the value of the annuity. This is the primary insurance value associated with annuitization (Brown, 2001). Since the utility function is assumed to be concave in consumption, this means that the first units of insurance are the most valuable. If an agent has no annuitized wealth purchasing an annuity will be quite valuable because it provides a minimum floor below which consumption will never fall. As more resources are annuitized, the floor rises and additional annuitization is valued less (Brown, 2001).

According to the literature seeking to explain the annuity puzzle, the level of pre-annuitized wealth may therefore play an important role in reducing the demand for annuities. Dushi and Webb (2004), for example, argue that U.S. citizens have a substantial fraction of annuities in their portfolio provided by Social Security, and identify this as a major determinant of the annuity puzzle.

All participants of the Norwegian National Insurance Scheme are provided with some insurance against longevity risk since they are guaranteed a minimum pension. Delaying the pension take-up is equivalent to buying an additional annuity. The insurance value of this additional unit of insurance may, however, be valued less since the agents already are provided with some insurance.

## **Credit Markets and Liquidity Constraints**

Annuities pay off over a long period of time and often involve a big upfront investment. An agent who is concerned with maximizing lifetime income would buy an annuity if the expected income stream provided by the annuity is greater than its cost or initial premium. If the agent's accumulated wealth is not sufficiently high he may need to borrow money in order to pay the initial premium. Agents may, however, be liquidity constrained. Liquidity constraints may exist due to lack of collateral, enforcement problems, limited liability, adverse selection, asymmetric information or other imperfections in the capital market.<sup>14</sup>

---

<sup>14</sup>See for example Jaffee and Stiglitz (1990) for a thorough discussion of credit rationing.

In Norway the flexible retirement rules make it possible to retire from the labour force without claiming old age pension benefits. An agent who retires from the labour force and delays the pension take-up must, however, finance current consumption. If capital markets were perfect, the agent would be able to borrow money today and repay later. If on the other hand borrowing opportunities are limited, an individual who has retired from the labour force must rely on previous savings or some income stream in order to delay pension take-up. In the absence of borrowing possibilities, an agent may therefore choose to claim his pension benefits as he retires in order to finance current consumption, even though he would get a greater expected lifetime income by delaying the take-up.

### **The Subjective Discount Factor**

A subjective discount factor is normally used when modelling lifetime utility. The subjective discount factor measures the extent to which an agent values future consumption relative to current consumption. It is thus a measure of how patient the agent is. The subjective discount factor is a preference parameter, and need not be related to the market discount factor (Romer, 2006).<sup>15</sup>

This suggests that if agents have strong preferences for current consumption and already have some pre-annuitized wealth, they may have less incentives to annuitize additional resources. In the following, I will assume that agents have a sufficiently high level of pre-annuitized wealth and are not concerned with the insurance value provided by the annuity. I will also disregard the bequest motive.

It is clear that if the agent is not concerned with the insurance value associated with annuitization, he will not buy the annuity if its money's worth is less than unity. If the money's worth exceeds unity, buying the annuity increases expected lifetime income. The agent, however, pays a price today and receives a stream of income in the future. The question remains whether an impatient consumer will buy the annuity.

Assuming that capital markets are perfect, the answer is that an impatient consumer may still want to purchase the annuity. The reason is that buying the annuity increases expected lifetime income, and in the presence of perfect capital markets the agent can easily move consumption from one period to another. Since utility is assumed to be increasing in consumption, the agent will be better off when the expected lifetime income increases.

If agents have strong preferences for consumption when they are relatively

---

<sup>15</sup>The market discount factor is simply  $\frac{1}{1+r}$ , where  $r$  is the market interest rate.

young and healthy, they may have incentives to claim their old-age pension benefits early in order to tilt the consumption path in favour of current consumption, even though this reduces expected lifetime income. This is true if for example the subjective discount factor is high and borrowing possibilities are limited.

### **Marital Status**

The institution of the family provides agents with risk-sharing opportunities. Kotlikoff and Spivak (1981) investigate family provision of insurance against the risk of running out of consumption resources because of greater than average longevity. The authors investigate the demand for individual annuities by married rather than single persons, and show that even small families may significantly improve the family members' well-being by sharing longevity risk.

In the case of marriage, Kotlikoff and Spivak (1981) argue, both individuals commonly agree to pool their resources while they are alive and to name each other as the major beneficiary in their wills. In this way, the risk of living too long is somewhat hedged by the other partner's potential death. Since couples may pool mortality risk, the insurance value of annuities is reduced, and they should therefore value annuities less than single individuals. There may also be implicit agreements between children and their parents: children provides for their parents if they live longer than expected and outlive their resources. Conversely, if the parents die sooner than expected, the children receive the unspent resources through a bequest.

All participants in the National Insurance Scheme are provided with some insurance against longevity risk since they receive at least the minimum pension. Delaying pension benefits provides the agent with additional insurance, but may also increase expected lifetime income. This may in itself be an argument in favour of delaying pension take-up. Marital status may influence the take-up decision in another way than in more traditional annuity demand theory, which emphasizes the insurance aspect. Being in a couple may for example facilitate delays in pension take-up if there is economic cooperation and pooling of resources.

### **Bequest Motives**

Introducing bequest motives, i.e. valuing the prospect of leaving wealth to family, friends or other good causes, complicates the analysis of the demand for annuities. Annuities entitle a person to a stream of payments in exchange of an initial



premium. When the annuitant deceases, the income stream ceases. According to Yaari (1965), risk-averse agents should hold a portfolio of annuitized and traditional assets in the presence of a bequest motive. The idea that bequest motives reduce optimal annuitization has considerable intuitive appeal: the single unavoidable cost of purchasing annuities is the foregone opportunity to bequeath that wealth (Lockwood, 2012).

According to Davidoff et al. (2005) agents with a bequest motive and access to an actuarially neutral annuity market should annuitize enough wealth to cover their planned future consumption. If the agents' pre-existing annuity income covers their desired consumption they should not annuitize any wealth.

Introducing bequest motives complicate the analysis in another dimension as well since they significantly reduce the cost of bearing lifespan risk. With a bequest motive agents are provided with a new means to insure against longer-than-expected longevity. Coile et al. (2002) argue that for individuals for whom a linear bequest motive is operative on the margin, there is no valuation of the annuity aspect, i.e., of the insurance value, of pension benefits. Consumption is never reduced to just pension benefits and the bequeathable wealth provides length-of-life insurance.<sup>16</sup>

The empirical findings of Bernheim (1991) indicate that a significant fraction of total saving in the U.S. is motivated solely by the desire to leave bequests. In particular, Bernheim finds that Social Security benefits significantly depress private annuity holdings among elderly individuals, indicating that a typical household would choose to maintain a positive fraction of its resources in bequeathable forms.

With regard to the Norwegian pension scheme, pension benefits can not be bequeathed. Sass et al. (2007) argue that agents can satisfy their bequest motive by setting aside the amount they wish to bequeath. They argue further that few households are likely to have a bequest motive that they cannot satisfy out of non-Social Security wealth.

---

<sup>16</sup>A linear bequest motive implies that the marginal utility of bequests is constant.

### 3.3 Asymmetric Information and Annuity Markets

As an insurance product, the market for annuities is potentially exposed to problems of moral hazard and adverse selection. Problems of moral hazard may arise if annuitants invest additional resources to raise survival probabilities than they would have done in the absence of the annuity. In the context of annuities, adverse selection means that people who expect to live longer are likely to have a higher demand for annuities, since they are worth more to them.

Studying the empirical importance of adverse selection and moral hazard is challenging, especially since it is difficult to distinguish empirically between the two phenomena, as emphasized by Chiappori and Salanie (2000).

#### Problems of Moral Hazard

In the context of annuities, moral hazard means that the holding of annuities may lead individuals to devote additional resources to life extension or to increasing survival probabilities. Sheshinski (2008) argues that this type of moral hazard leads to an inefficient resource allocation, characterized by overinvestment in raising survival probabilities.

Sheshinski (2008) assumes that survival functions depend on a parameter that individuals are able to affect. Individuals are able to affect the value of the parameter by devoting additional resources, such as medical care and healthy nutrition.

In a first-best situation, insurance firms are able to monitor the resources devoted to life extension and make the rate of return on annuities depend on its level. It should be emphasized that this first-best situation is a purely theoretical possibility. In a second-best situation, the level of expenditures on longevity is private, and the insurance firms are unable to make the rate of return on annuities conditional on the level of these expenditures.

Finkelstein and Poterba (2004) suggest that moral hazard is likely to play a smaller role in annuity markets than in many other insurance markets. Sheshinski (2008) argues, however, that even if moral hazard were to play a small role in the annuity market, it is important to understand the potential direction of its effect. Philipson and Becker (1998) note that the presence of an annuity affects the amount of resources devoted to life extension. Davies and Kuhn (1992) also emphasize the importance of moral hazard in annuity markets, and argue that a complete analysis of annuity markets needs to consider both adverse selection

and moral hazard.

### **Problems of Adverse Selection**

The money's worth of an annuity is increasing in the survival rate. This means that annuities are worth more to people who expect to live longer. There is therefore reason to suspect that annuity markets are plagued by adverse selection.

Theoretical research starting with Akerlof (1970) and Rothschild and Stiglitz (1976), has emphasized the negative welfare consequences of adverse selection in insurance markets. Among economists there is widespread agreement that adverse selection is likely to be present in annuity markets (Cannon and Tonks, 2008: 192).

The problem of adverse selection arises because individuals have differing expected longevity and, more importantly, the information about their expected longevity is private. In a first-best situation with perfect information, the insurer would offer actuarially fair annuities to all individuals, taking into account every individual's expected longevity. In a second-best situation with imperfect information, annuities are offered at the same price to all individuals - or groups of individuals. If all individuals are identical to the insurer, there will be a pooling equilibrium in which the equilibrium price is a function of the average longevity of the annuitants, weighted by the equilibrium amount purchased by different risk-classes.<sup>17</sup> An important implication is that the amount of annuities purchased by individuals with higher than average expected longevity will be relatively high, while the opposite holds for individuals with lower than average life expectancy (Sheshinski, 2008: 67). If the insurer is able to identify various risk-classes he may offer annuities at different prices to individuals belonging to different risk-classes. Unless he has perfect information, the problem of adverse selection remains. The scope of adverse selection is, however, reduced as the insurer gets more information and is able to diversify the annuities offered.

### **The Lemons Problem and Market Breakdown**

Problems of adverse selection may lead to market breakdown - often referred to as the *lemons problem*.<sup>18</sup> If the individuals are identical to the insurer, the price of an annuity is a function of the average longevity of the annuitants and will

---

<sup>17</sup>A pooling equilibrium is an equilibrium in which the individuals' risk classes are unknown and can not be revealed by their actions (Sheshinski, 2008: 67). High-risk individuals are in this context the long-lived.

<sup>18</sup>See Akerlof (1970).

equal the average money's worth. If an individual expects to live longer than the average mortality rates of the entire population on which annuities are priced, he or she will find annuities more attractive than those who expect to have a shorter life span. Ex post, premiums would have to rise if the insurance company is to remain solvent. This decreases the attraction for those with a shorter life expectancy, and their demand drops further. In this way the company is left with "lemons" or bad-risks - in this case, the long-lived. In the end, it may no longer be viable for the insurance company to stay in the market. The greater the adverse selection, the higher premium cost of a given annuity, and the greater the total loss for society.

The possible failure of annuity markets is an argument in favour of a public pension scheme providing insurance against outliving one's resources.

### **Adverse Selection in Annuity Markets: Empirical Evidence**

If agents were systematically wrong about their expected longevity, self-selection into the annuity market would not be a problem. It is, however, reasonable to assume that the subjective and the objective survival rates are correlated. The findings of Hurd and McGarry (1995) suggest that this is indeed the case. In the Health and Retirement Survey, respondents were asked about their subjective survival rates. Hurd and McGarry (1995) find that the subjective probabilities of surviving behave like actual probabilities of survival and that they aggregate to population probabilities. They also find that the subjective probabilities of survival covary with other variables in the same way that actual survival probabilities vary with the same variables. For example, respondents with a higher socioeconomic status gave higher probabilities of survival whereas respondents who smoke gave lower probabilities.

Empirical evidence suggests that annuity markets are plagued by adverse selection. As stressed by Chiappori and Salanie (2000), the empirical importance of adverse selection in annuity markets is, however, debated. Brown (2001) use U.S. data and find that annuitant mortality rates are systematically lower than those for the general population. Finkelstein and Poterba (2004) use a data set consisting of annuitants at a large U.K. insurance company. They find, among other things, evidence of selection in mortality rates. These selection effects, they argue, are large. Furthermore, the findings of Rothschild (2009) indicate that the market created by the U.K.'s 1808 Life Annuity Act was characterized by adverse selection. He finds that annuitants were longer lived than the average

individual in the population.

### **The Money's Worth and Pension Take-Up**

Two important determinants of annuity demand are the expected longevity, which relates to the money's worth of the annuity, and the individuals' risk aversion. Annuities provide insurance against the risk of outliving one's resources. For risk to be an important determinant, the risk of outliving one's resources must, however, be a relevant risk.

The savings of Norwegian citizens in the age group 55 - 64 years and of individuals who have retired are relatively high (Halvorsen, 2011). It is therefore reasonable to assume that the insurance value of delaying pension-take up is less important to Norwegian citizens. In the empirical analysis I will therefore use a measure related to the money's worth of delaying pension take-up to explain claiming behaviour, and disregard the insurance aspect of delaying pension take-up.

## 4 Economic Theory of Household Behaviour

### 4.1 Overview

The scope of this thesis is to investigate whether there exists empirical evidence suggesting that Norwegian couples cooperate with regard to pension take-up. In the previous chapter I discussed some factors that may affect the take-up decision using theory for the demand for annuities. In order to complete the theoretical framework of my thesis I will in this chapter present four models of household behaviour.

Since Samuelson (1956) pointed out that the fundamental unit on the demand side is the "family", various economic models have been proposed to explain household demand. Different assumptions regarding preferences, degree of cooperation and ability to make binding agreements have implications for the models' predictions about expenditure patterns and the extent to which the household pools its resources. Basically there are four broad options for modelling household behaviour: the unitary approach, non-cooperative models, collective models and bargaining models (Browning and Lechene, 2001). In this chapter I will present contributions from each approach. It is, however, beyond the scope of this chapter to give an exhaustive overview of the existing economic models of household behaviour. The scope is rather to show some of the variety in this subfield of economics and how different assumptions give different predictions with regard to cooperation on pension take-up.

I start by presenting the unitary model, which is the traditional way of modelling household behaviour. The unitary approach assumes that the household acts as one agent, by maximizing a social welfare function subject to the household budget constraint. Since the 1980's, several non-unitary models of household behaviour have been developed. A common feature of the non-unitary models is that every member of the household is represented by distinct preferences. The various non-unitary models rest, however, on different assumptions with regard to preferences and the possibility to make binding agreements. As a consequence their predictions with regard to household demands and cooperation differ. I will present a non-cooperative model, a collective model and a cooperative bargaining model.

The economic models of household behaviour are normally concerned with how household demands for various goods are determined. They make predic-

tions about expenditure patterns and how the demand changes as the distribution of income and prices change. These models were obviously not developed to study the pension take-up decision in particular, but they are based on assumptions and give insight that can be used to make predictions about the degree of cooperation on claiming pension benefits.

Two comments need to be made at this point. First, the models that I will present are static models of household behaviour. An alternative approach would be to present models with an intertemporal dimension. In my point of view that would, however, complicate matters unnecessarily. Second, I assume the existence of one private, one normal good and one public good. An alternative approach would be to study household demand for annuities. The exposition in the previous section showed, however, that several factors influence annuity demand. I also argued that the insurance value of delaying pension take-up may be of minor importance to the individuals in the sample of my empirical study in chapter 5. In chapter 5 I will therefore investigate to which extent the money's worth of delaying pension take-up explains claiming behaviour, and disregard the insurance value of a delay. With regard to the empirical analysis, the relevant theoretical framework is thus the models' predictions with regard to cooperation and the extent to which the households pool their resources.

The rest of this chapter is organized as follows: In the next section I will briefly give examples of private goods and public goods in a multi-person household, as well as a brief description of externalities in consumption. In the third section I will present three broad types of preferences and their properties. Four models of household behaviour and their predictions with regard to cooperation on the claiming of pension benefits are presented in the fourth section. In the fifth section I refer to some empirical findings to which this thesis relates.

## 4.2 Goods and Consumption in a Two-Person Household

Within the household some of the goods are consumed jointly and non-exclusively. The existence of such public goods may be a source of substantial economic gains.<sup>19</sup> This section emphasizes the distinction between private and public good in a multi-person household.

### Private Goods

Private goods are consumed non-jointly and are characterized by an exclusion restriction property: the fact that one person consumes a particular apple *de facto* excludes anyone else from consuming the same apple. In a multi-person household some goods are private in nature. Examples of such goods are food and clothes.

### Public Goods

Public goods are consumed jointly and non-exclusively in the household. With public goods no exclusion restriction exists: that a person enjoys seeing a beautiful painting in her living-room does not preclude her spouse from enjoying it just as much. Examples of public goods in the household are expenditures on housing and children.

Due to public goods, there may be substantial economic gains from living in a multi-person household.<sup>20</sup> The reason is that several household members may derive utility from the same good. On the contrary, there are no such gains from goods that are non-excludable in nature in a single-person household.

Browning et al. (2011) makes several remarks with regard to the distinction between private and public goods. Some commodities are sometimes used publicly and sometimes privately, and a sharp distinction between the two types of goods is here assumed for the sake of simplicity. First, many commodities are sometimes used publicly and sometimes privately; for instance, a person can use the car to go to work, or the whole family can use the car together. Second,

---

<sup>19</sup>According to Cowell (2005), a good is pure public good if it is non-rival and non-excludable. In this context, I use the term "public good" to refer to goods that are consumed jointly and non-exclusively within the household. These goods are, however, not public goods in a wider context. Alternative terms could be "local public goods" or "public goods in the household" to distinguish them from pure public goods as specified by Cowell (2005). My use of the term is in line with, for example, Browning et al. (2011).

<sup>20</sup>There may be other economic gains from living in a multi-person household as well. Agents may for example gain by specializing in different tasks and there may be economies of scale in household production.



the privateness or publicness of a good may be dependent of the type of control existing on that good and who exerts it. For example parents typically have control over the (private consumption) of their young children.

### **Externalities in Consumption**

Externalities within the household exist if the private consumption of a household member affects the utility of other household members. Such externalities are captured by the household members' preferences.

An example of a negative externality is smoking. If a person smokes, this may affect the well-being or utility of the other household members negatively. Positive externalities, on the other hand, may exist if the household members care for each other, and derives utility from other members' consumption and utility.

### 4.3 Preferences

The underlying preferences in the models of household behaviour have important implications for the models' predictions. It is therefore useful to discuss different types of preferences before introducing the models. In microeconomic theory, consumer preferences are usually assumed to be complete, reflexive, transitive and continuous. It can be shown that when the preference ordering satisfies these requirements, it can be represented by a continuous utility function (Varian, 1992: 95). This means that the very existence of a utility function, and the resulting consumer maximization problem, relies on strict assumptions made about preferences.

In the context of family behaviour, preferences can broadly be divided into three categories. I will use the terminology used in Pollak (2003) and Browning et al. (2011), and refer to these categories as egotistic preferences, deferential preferences and non-deferential preferences. It should, however, be emphasized that there is no consensus among authors on which terminology to adopt.

In the following I will use a specific context, namely a household consisting of two persons  $a$  and  $b$ , to discuss preferences. To keep things simple I will assume the existence of one public good,  $Q$ , and one private good,  $q$ .<sup>21</sup> Let the two persons,  $a$  and  $b$ , have utility functions  $U^a$  and  $U^b$  and felicity functions  $u^a$  and  $u^b$ , respectively. The felicity function measures the agents' instantaneous utility, or private utility, from consumption (Browning et al., 2011). Let  $Q$  be the amount of public goods consumed by the household, while  $q^a$  and  $q^b$  are the amounts of private goods that are consumed by  $a$  and  $b$  respectively. This notation will be used throughout the chapter.

#### Egotistic preferences

Egotistic preferences refer to the case in which each individual only cares about his or her own consumption, and this way of modelling preferences is the default assumption in most subfields of economics (Pollak, 2003).<sup>22</sup> In the absence of externalities, these preferences can be formulated in the following way:

$$\begin{aligned} U^a(Q, q^a) &= u^a(Q, q^a) \\ U^b(Q, q^b) &= u^b(Q, q^b) \end{aligned} \tag{3}$$

---

<sup>21</sup>An alternative approach is to let  $Q$  be a vector of  $N$  public goods and  $q$  be a vector of  $n$  private goods.

<sup>22</sup>Egotistic preferences are sometimes referred to as egoistic preferences.

Both persons' preferences are defined solely over private consumption and the level of the public good, and the other person's consumption level does not enter the utility function. This means that a person's total utility (measured by the utility function) and private utility (measured by the felicity function) coincide.

### Deferential preferences

Another way of modelling preferences is by allowing for *caring* or *interdependence*. Deferential preferences are a particular type of interdependent preferences, and can be described as follows:

$$\begin{aligned} U^a(Q, q^a, q^b) &= W^a(u^a(Q, q^a), u^b(Q, q^b)) \\ U^b(Q, q^a, q^b) &= W^b(u^a(Q, q^a), u^b(Q, q^b)) \end{aligned} \quad (4)$$

where the aggregator functions  $W^a(.,.)$  and  $W^b(.,.)$  are Bergson-Samuelson social welfare functions, reflecting the "weights" that each person places on their own felicity functions relative to the other's. Each person's utility is directly a function of both individuals' felicity levels (Varian, 2006: 620-621).

Becker (1991) suggests that we call such preferences *altruistic*. Pollak (2003), on the other hand, argues that it is more descriptive to call these preferences *deferential* since each person defers to the judgement of the other regarding their consumption: person  $a$  is not directly concerned with person  $b$ 's consumption level, but rather with person  $b$ 's felicity level.

### Non-deferential preferences

Non-deferential preferences are another kind of interdependent preferences. With non-deferential preferences, person  $a$  and person  $b$  care directly about each other's consumption patterns. This type of preferences can be written in the following way:

$$\begin{aligned} U^a(Q, q^a, q^b) &= u^a(Q, q^a, q^a) \\ U^b(Q, q^a, q^b) &= u^b(Q, q^a, q^b) \end{aligned} \quad (5)$$

Non-deferential preferences exhibit a higher degree of interdependence than deferential preferences since each person cares directly about the other person's consumption pattern, instead of the partner's felicity level. This is why they are labeled non-deferential - the persons do not defer to the judgement of the other

regarding their consumption.

Say that person  $b$  enjoys drinking beer and eating hamburgers. With non-deferential preferences person  $a$  may prefer that person  $b$  drinks less beer or have fewer hamburgers, because it is bad for person  $b$ 's health, even though person  $b$  is happy to eat hamburgers and drink beer. Put differently, non-deferential preferences are compatible with each person preferring a different consumption pattern for the other person than the other person would choose for himself or herself. The motivation may be "altruism", but it can also be "paternalism" (Pollak, 2003: 118)

## 4.4 Models of Household Behaviour

In this section I will present four models of household behaviour and their predictions with regard to cooperation on claiming pension benefits. This thesis investigates whether Norwegian couples coordinate with regard to pension take-up. I am therefore particularly concerned with the models' predictions of household money management: that is, whether couples choose to pool their resources (*one-pot-strategy*) or independent money management (*two-pot-strategy*). A one-pot-strategy means that the partners pool their incomes into a "household pot", while a two-pot-strategy means that the partners control their own income.

If couples choose a one-pot-strategy there is the possibility of cooperation with regard to pension take-up. If independent money management is the chosen strategy, each member of the couple controls his or her own income and the claiming of old-age pension benefits is more likely to be an individual decision. Two comments must be made at this point. First, even if the couple chooses a two-pot strategy so that each member controls his or her own income, there is the possibility of cooperation if preferences for example are interdependent or if the couple can make binding and enforceable agreements. Secondly, even if the household chooses a one-pot-strategy there may not be cooperation on the pension take-up decision. In some bargaining models, for example, a person's contribution to the household pot may be important for that member's bargaining power and, as a consequence, for that member's share of household consumption after the pooling of resources. He or she may therefore be reluctant to delay pension take-up, even if this increases expected lifetime income, since this reduces his or her bargaining power for some period.

The models I will present are not primarily concerned with money management, but implicitly makes assumptions in this regard. I will start by introducing the unitary model, the standard framework for modelling household behaviour. The unitary approach, which can be traced back to Samuelson (1956), is to assume that the household is a single decision unit which maximizes a common utility function with respect to a common budget constraint.

Since the 1980s this approach has been challenged by non-unitary models of household behaviour. In the non-unitary models every member of the household is represented by distinct preferences and these models can roughly be divided into two categories: strategic (non-cooperative) models and collective (cooperative) models. The second model I will introduce is an example of the former, while the third is an example of the latter. Lastly, I will present a cooperative

bargaining model and discuss the importance of threat points.

## The Unitary Model

Until recently the standard approach to modelling household behaviour assumed the existence of a household welfare function that aggregates the preferences of all members. Maximizing this welfare function subject to the appropriate budget constraint, the sum of all household incomes, yields demand functions for goods and leisure. This approach is known as "the unitary model", reflecting how the household acts, namely as one (Chiappori et al., 1993). This model has been extended far beyond standard demand analysis to include the determinants of education, health, fertility, child fostering, migration and labour supply (Chiappori et al., 1993).

Samuelson (1956) was one of the first modern economists to address the problem of family preferences, and the unitary approach can be traced back to his article about social indifference curves. In this article Samuelson proves the nonexistence of community indifference curves, but argues that this result does not apply to family preferences. Conventional theory can be saved, he argues, by adopting the hypothesis of a consistent "family consensus" that represents a meeting of the minds or a compromise between them (Samuelson, 1956). By conventional theory he refers to the neoclassical theory of a rational consumer who maximizes utility subject to a budget constraint. Samuelson does not, however, suggest how such consensus is reached. In fact, many textbooks in microeconomics adopt the unitary model, without discussing the rationale behind it. In the chapter about the consumer, Cowell (2005) refers to "the individual" and the "household" almost interchangeably.<sup>23</sup>

### *Solving the Model*

Let  $P$  be the price of the public good,  $Q$ , and  $p$  the price of the private good,  $q$ . Let  $Y^a$  and  $Y^b$  denote the income of  $a$  and  $b$  respectively and let  $Y$  denote total household income. The household budget constraint is given by:

$$P \cdot Q + p \cdot (q^a + q^b) \geq Y^a + Y^b \equiv Y$$

---

<sup>23</sup>Cowell (2005) argues that "this distinction does not matter as long as (a) if the consumer is a multi-person household, that household's membership is taken as given and (b) any multi-person household acts as though it were a single unit" (Cowell, 2005: 68-69). Cowell, however, does not provide any theoretical justification for why these are reasonable assumptions.

We assume the existence of a household welfare function,  $\tilde{U}(Q, q^a, q^b)$ , that aggregates the preferences of all household members. Assuming that  $\tilde{U}(Q, q^a, q^b)$  is continuously differentiable and strictly concave, we know that the budget constraint will hold with equality. The household's maximization problem can then be written as the Lagrangian:

$$\mathcal{L} = \tilde{U}(Q, q^a, q^b) - \lambda(PQ + p(q^a + q^b) - Y)$$

The solution of this problem leads to demand functions of the following form:

$$\begin{aligned} Q &= Q(P, p, Y) \\ q^a &= q^a(P, p, Y) \\ q^b &= q^b(P, p, Y) \end{aligned} \tag{6}$$

An important implication of the unitary assumptions is that the demands for the private and public goods only depend on prices and total household income, and are independent of the distribution of income. Another central feature, that follows from the first-order conditions, is that at optimum

$$\frac{\partial \tilde{U}(Q, q^a, q^b)}{\partial q^a} = \frac{\partial \tilde{U}(Q, q^a, q^b)}{\partial q^b} \Rightarrow \frac{\partial q^a}{\partial Y} = \frac{\partial q^b}{\partial Y}$$

At optimum the utility gain of a unit increase in person  $a$ 's consumption of the private good is the same as the utility gain of a unit increase in person  $b$ 's consumption of the private good. It follows that a marginal increase in household income should increase the consumption of the private good by equal amounts. Since  $dY = dY^a + dY^b$ , it follows that

$$\frac{\partial q^a}{\partial Y^a} = \frac{\partial q^a}{\partial Y^b} = \frac{\partial q^b}{\partial Y^a} = \frac{\partial q^b}{\partial Y^b}, \quad \frac{\partial \tilde{U}(Q, q^a, q^b)}{\partial Y^a} = \frac{\partial \tilde{U}(Q, q^a, q^b)}{\partial Y^b} \tag{7}$$

This property is known as the *income pooling hypothesis*. When the income pooling hypothesis is satisfied, the marginal utility of the household is independent of the source of income, and so is the demand for the goods of the two persons.

Bütikofer et al. (2009) argue that the term "income pooling hypothesis" is unfortunate since bargaining models as well may assume that the household members first pool their resources and then divide the pool according to their bargaining power. Under these circumstances, only rarely and by exception,

will the income pooling hypothesis as described by (7), hold.<sup>24</sup> Apps and Rees (2007) argue that "anonymity" would be a more proper term for what (7) implies, namely that the identity of the income contributor does not matter for household decisions or individual welfare.

An extension of the simple unitary model presented above, is to include the felicity functions of the household members in the social welfare function. In order for a model to be unitary, a necessary condition is that the Pareto-weights measuring the relative importance of the felicity functions, are constant. The household utility function can then be written as:

$$\hat{U}(Q, q^a, q^b) = \mu \cdot u^a(q^a, Q) + (1 - \mu) \cdot u^b(q^b, Q)$$

Maximizing this utility function to the proper household budget constraint yields demand functions like in (6), and the income pooling hypothesis, as summarized in (7), will hold.

## A Non-Cooperative Model

The non-unitary models reject the existence of a unitary utility function. The basic premise for this category of models is that households consist of individuals with distinct preferences which can not be aggregated by a social welfare function. According to these models, the key to study household behaviour is to study individual behaviour and some decision process within the household.

Non-unitary models can be divided into two broad categories: non-cooperative models and cooperative models. Non-cooperative models, also known as strategic models, are characterized by the lack of any cooperation. Ermisch (2003), for example, assumes that the family members are unable to communicate, and so the best they can do is to behave according to the definition of a Nash equilibrium. A perhaps more realistic way of motivating the non-cooperative models is by observing that legal institutions do not provide for external enforcement of contracts with regard to consumption, labour supply, and allocation within marriage (Lundberg and Pollak, 1994). The non-cooperative model presented here is based on Browning et al. (2011).

Assume that both members of the couple have egotistic preferences as described by (3) and that both members control his or her own exogenous income. They make each a voluntary contribution to the purchase of the public good,  $Q^a$

---

<sup>24</sup>For examples see Browning et al. (2011).



and  $Q^b$ , and use the remaining money to buy the private goods for themselves. Let  $Q = Q^a + Q^b$  be the total household demand of the public good. The agents' maximization problems are thus:

$$\begin{aligned} \max_{Q^a, q^a} \{ & u^a(Q^a + Q^b, q^a) \quad \text{subject to} \quad P \cdot Q^a + p \cdot q^a = Y^a \} \\ \max_{Q^b, q^b} \{ & u^b(Q^a + Q^b, q^b) \quad \text{subject to} \quad P \cdot Q^b + p \cdot q^b = Y^b \} \end{aligned} \quad (8)$$

We can make assumptions about the functional form of the utility functions to get an explicit solution of these maximization problems. Ermisch (2003), for example, assumes log-linear utilities of the following form:

$$\begin{aligned} U^a(Q^a + Q^b, q^a) &= \alpha \ln(q^a) + (1 - \alpha) \ln(Q^a + Q^b) \\ U^b(Q^a + Q^b, q^b) &= \beta \ln(q^b) + (1 - \beta) \ln(Q^a + Q^b) \end{aligned} \quad (9)$$

The parameters  $\alpha$  and  $\beta$  represent respectively the weights that person  $a$  and person  $b$  put on the private good relative to the public good.

Since this is a non-cooperative or strategic model, both persons maximize their own utility, taking the other person's contribution to the purchase of the public good as given. The maximization problems for person  $a$  and  $b$  are then:

$$\begin{aligned} \max_{Q^a, q^a} U^a(Q^a + Q^b, q^a; Q^b) &= \alpha \ln(q^a) + (1 - \alpha) \ln(Q^a + Q^b) \\ \text{subject to} \quad & p \cdot q^a + P \cdot Q^a = Y^a \end{aligned} \quad (10)$$

$$\begin{aligned} \max_{Q^b, q^b} U^b(Q^a + Q^b, q^b; Q^a) &= \beta \ln(q^b) + (1 - \beta) \ln(Q^a + Q^b) \\ \text{subject to} \quad & p \cdot q^b + P \cdot Q^b = Y^b \end{aligned} \quad (11)$$

Assuming that both goods are normal, this interaction has exactly one Nash equilibrium, which can take one of two forms. The first form is an interior solution where both persons contribute to the public good. Assuming an interior solution of the problem, we get the following demand functions for the public

good<sup>25</sup>:

$$Q^a = \frac{(1 - \alpha)Y^a}{P} - \alpha Q^b \quad (12)$$

$$Q^b = \frac{(1 - \beta)Y^b}{P} - \beta Q^a \quad (13)$$

(15) and (16) represent the strategies for both individuals and are often called their "reaction functions". The reaction functions show that the best strategy for person  $a$  is to reduce his or her contribution to the public good when person  $b$  increases his or her contribution, and the amount of this reduction depends on the preferences, captured by the parameter  $\alpha$ . In general lower values of  $\alpha$  and  $\beta$  implies that both persons' utility levels depend strongly on the level of the public good. In particular, we have that

$$\begin{aligned} \lim_{\alpha \rightarrow 0} Q^a &= \lim_{\alpha \rightarrow 0} \left[ \frac{(1 - \alpha)Y^a}{P} - \alpha Q^b \right] = \frac{Y^a}{P} \\ \lim_{\beta \rightarrow 0} Q^b &= \lim_{\beta \rightarrow 0} \left[ \frac{(1 - \beta)Y^b}{P} - \beta Q^a \right] = \frac{Y^b}{P} \end{aligned} \quad (14)$$

This means that as  $\alpha$  and  $\beta$  go to zero, both persons will devote all their income to the purchase of the public good, independently of the other person's contribution. From person  $b$ 's reaction function, we see that:

- If person  $a$  does not contribute to the purchase of the public good, person  $b$  will supply  $\frac{(1-\beta)Y^b}{P}$ .
- In order to make person  $a$  not contribute, person  $b$  must supply an amount greater than or equal to  $\frac{(1-\alpha)Y^a}{\alpha P}$ .
- If  $(1 - \beta)Y^b < \frac{(1-\alpha)Y^a}{\alpha}$  they will both contribute.

The intersection of the two reaction functions yields the interior solution (Ermisch, 2003: 23). The Nash equilibrium is then given by:

$$Q_N^a = \frac{(1 - \alpha)Y^a - \alpha(1 - \beta)Y^b}{P(1 - \alpha\beta)} \quad (15)$$

$$Q_N^b = \frac{(1 - \beta)Y^b - \beta(1 - \alpha)Y^a}{P(1 - \alpha\beta)} \quad (16)$$

---

<sup>25</sup>See appendix A for calculations

It follows that the total purchase of the public good is given by:

$$Q_N = Q_N^a + Q_N^b = \frac{(1 - \alpha)(1 - \beta)(Y^a + Y^b)}{P(1 - \alpha\beta)} \quad (17)$$

The demands for the private good are given by:

$$q_N^a = \frac{\alpha(1 - \beta)(Y^a + Y^b)}{p(1 - \alpha\beta)} \quad (18)$$

$$q_N^b = \frac{\beta(1 - \alpha)(Y^a + Y^b)}{p(1 - \alpha\beta)} \quad (19)$$

We conclude that when both members contribute to the purchase of the public good, household's market demands for both the public good and the private good depend only on total household income and not on how it is distributed. Redistribution of income has no effect on the choice of the level of public good nor the individuals' private consumption (Ermisch, 2003: 24). This means that we have income pooling although we are considering a non-unitary model. This result shows that while income pooling is a necessary condition for the unitary model, it is not a sufficient one (Browning et al., 2011: 114). The income pooling in this case is a local property, and it only holds as long as both persons contribute to the public good.

The second form of the Nash equilibrium is one in which only one person contributes to the public good. We know that person  $a$  will not contribute if:

$$\frac{Y^a}{Y^a + Y^b} < \frac{\alpha(1 - \beta)}{1 - \alpha\beta}$$

This means that person  $a$  will not contribute when his or her share of the family income is relatively small. It is clear from the expression above that what is a "small share" depends on the preferences of each individual. The inequality above is more likely to hold if person  $a$  sufficiently favours private consumption over the private good, i.e.  $\alpha$  is "large", and / or person  $b$  sufficiently favours the public good, i.e.  $\beta$  is "small" (Ermisch, 2003: 25). In this case we get that:

$$Q_N = Q_N^b = \frac{(1 - \beta)Y^b}{P}, \quad q_N^a = \frac{Y^a}{p} \quad \text{and} \quad q_N^b = \frac{\beta Y^b}{p} \quad (20)$$

Redistribution from person  $b$  to person  $a$  reduces  $Q_N$  and  $q_N^b$ . Conversely, redistribution in the other direction increases both  $Q_N$  and  $q_N^b$ . In other words, the income pooling property does not hold.

The non-cooperative models rest on very strict assumptions. Ermisch (2003) argues, however, that the model can indicate what the "fallback position" would be if the communication and bargaining within the family breaks down, and how individual preferences and incomes affect this fallback position.

An extension of this non-cooperative model is to allow for altruism. Becker (1974) defines the "head" of the household as the family member who transfers purchasing power or money to the other members because he or she cares about their welfare. Becker argues that a family with a head has the following properties: "A redistribution of income among members does not affect the consumption or welfare of any member because it simply induces offsetting changes in transfers from the head. Not only the head but other members too act "as if" they "loved" all members, even when they are really selfish, in the sense that they maximize not their own income alone but family income" (Becker, 1974). Since the head is altruistic, all decisions are internalized and the household behaves as though it is one.

## A Collective Model

The collective models are cooperative models based on the hypothesis that the household decision process leads to Pareto-efficient outcomes.<sup>26</sup> An economic situation is Pareto-efficient if there is no way to make some group of people better off without making some other group of people worse off. Collective models assume that players can communicate freely and make binding, costlessly enforceable agreements. In this way the couple can achieve an allocation such that one person can not be made better off without making the other person worse off. The process that leads to the Pareto-efficient allocation is not necessarily specified and could in principle be a function of any variable that affects the household environment. There are different ways of modelling the collective model. The model presented below is based on Sheshinski (2008).<sup>27</sup>

Assume that the preferences of both persons are egotistic. A Pareto-efficient

---

<sup>26</sup>There is no consensus on the terminology and the terms may cause confusion. I use the term non-unitary model to refer to all models that are not unitary, and in line with Browning et al. (2011) and Chiappori and Donni (2009), I use the term collective model to refer the non-unitary models that are based on the hypothesis that the decision process leads to Pareto-efficient outcomes. Phipps and Burton (1998), on the other hand, argue that the common characteristic of collective models is that husbands and wives are not assumed to have identical utility functions, i.e. what I refer to as non-unitary models.

<sup>27</sup>See for example Chiappori and Donni (2009) and Browning et al. (2011) for alternative approaches.

allocation is the solution to:

$$\begin{aligned} & \max_{q^a, Q} U^a(Q, q^a) \\ & \text{subject to } U^b(Q, q^b) \geq \bar{U}^b \text{ and } p(q^a + q^b) + PQ = Y^a + Y^b \end{aligned} \quad (21)$$

In other words, we maximize utility for one individual subject to the utility level of the other person not falling below some target level and the budget constraint.

Since we have assumed that the utility functions are well-behaved, both constraints will hold with equality. The first-order conditions are:

$$\begin{aligned} \frac{\partial U^a(Q, q^a)}{\partial q^a} &= \mu \cdot \frac{\partial U^b(Q, q^b)}{\partial q^b} \\ \frac{\frac{\partial U^a(Q, q^a)}{\partial Q}}{\frac{\partial U^a(Q, q^a)}{\partial q^a}} + \frac{\frac{\partial U^b(Q, q^b)}{\partial Q}}{\frac{\partial U^b(Q, q^b)}{\partial q^b}} &= \frac{P}{p} \end{aligned} \quad (22)$$

where  $\mu$  is the Lagrange multiplier associated with the utility constraint.<sup>28</sup> The second line in (23) states that in the cooperative equilibrium the sum of both persons' marginal rates of substitutions between the public and the private good equals the relative price of the public good.<sup>29</sup>

By varying the target levels of utility for person  $b$  we can trace out the entire utility possibility frontier. This frontier is the locus of all Pareto optimal utility levels for the two persons for given incomes and prices. Along the utility possibility frontier, higher welfare for one person implies lower welfare for the other, and there is therefore clearly a potential for conflict.

The demand functions take the following form:

$$\begin{aligned} Q &= Q(Y^a + Y^b, p, P, \mu) \\ q^a &= q^a(Y^a + Y^b, p, P, \mu) \\ q^b &= q^b(Y^a + Y^b, p, P, \mu) \end{aligned}$$

The implicit utility weighting factor  $\mu$  indicates the location chosen on the utility possibility frontier. In general,  $\mu$  is a function of individual incomes and prices, i.e.,  $\mu = \mu(Y^a, Y^b, p, P)$ .<sup>30</sup>  $\mu$  can also be interpreted as an index of the distribution of power within the household. The factors affecting  $\mu$  would

<sup>28</sup>More precisely,  $\mu$  is the shadow value for person  $a$  of relaxing the utility constraint, i.e., it is  $a$ 's marginal utility from relaxing the constraint that  $U^b(Q, q^b) \geq \bar{U}^b$ .

<sup>29</sup>This property is known as the Samuelson condition for efficient provision of public goods.

<sup>30</sup>It should be noted that if  $\mu$  is a constant the problem boils down to the unitary model.

then include "extra-environmental parameters" (McElroy, 1990) or "distribution factors" (Browning and Chiappori, 1998). These are variables that have an impact on the distribution of power within the household without affecting neither preferences nor the budget constraint. Examples include the relative incomes of household members, divorce laws, social attitudes to the roles of men and women and the outside option of the different members.

## A Cooperative Bargaining Model

The process that leads to the Pareto-efficient allocation in the collective models is not necessarily specified. If we specify the bargaining process, the model becomes a bargaining model. A typical cooperative bargaining model of marriage begins with a household that consists of two members, whose preferences are egotistic. If the couple does not reach an agreement, then the payoff received is represented by a "threat point"  $(T^a, T^b)$  (Lundberg and Pollak, 1996).

In divorce-threat bargaining models, the threat point is the maximal level of utility attainable outside marriage. In the separate spheres bargaining model of Lundberg and Pollak (1993) the threat point is the utility associated with an inefficient non-cooperative equilibrium.<sup>31</sup> Let  $Z^a$  and  $Z^b$  denote the extra-environmental factors that affect the threat points of  $a$  and  $b$  respectively.

The Nash bargaining model provides the leading solution concept in bargaining models of marriage. In this model, the household is thought to maximize the product of the gains from cooperation subject to the household budget constraint:

$$\begin{aligned} \max_{q^a, q^b, Q} N &= [U^a(q^a, Q) - T^a(Z^a)] [U^b(q^b, Q) - T^b(Z^b)] \\ &\text{subject to } p(q^a + q^b) + PQ \leq Y^a + Y^b \end{aligned} \quad (23)$$

The utility received by  $a$  and  $b$  in the Nash bargaining solution depends upon the threat points. The higher one's utility at the threat point, the higher utility in the Nash bargaining solution. A person's utility at the threat point can therefore be thought of as a measure of his or her bargaining power.

The household demand for both the private and the public good will depend on prices, household income and the determinants of the threat points (Lundberg and Pollak, 1996).

---

<sup>31</sup>For example the equilibrium in the non-cooperative model.

## **The One-Pot-Strategy and the Income Pooling Hypothesis**

The terms "income pooling" and "income pooling hypothesis" may cause some confusion. The income pooling hypothesis refers to the property that the household demands for various goods are independent of the distribution of income within the household. The pooling of household incomes, however, does not imply that the income pooling hypothesis necessarily holds. In some bargaining models the household members first pool their resources and then divide the pool according to their bargaining power. If relative income is a determinant of bargaining power, household demand for various goods will not be independent of the distribution of income. In particular, a change in the relative income shares will affect the bargaining power.

### **The Claiming of Old-Age Pension Benefits: An Example of the Models' Predictions**

When an agent eligible for early pension take-up turns 62, she has four possibilities: (1) retire and claim benefits; (2) not retire and claim benefits; (3) retire and not claim benefits; and (4) retire and claim benefits. The third possibility may not be feasible for all agents, since in this case one must rely on previous savings, non-wage income or some other income stream to finance current consumption. This is the case I will consider below.

Let us assume that person  $a$  has decided to retire as she turns 62, and that the relative money's worth of delaying pension take-up is greater than unity. We assume that her savings are not sufficiently high to finance consumption in the period of delay, and that she does not have any non-wage income. We assume that agents are concerned with maximizing expected income, and investigate the predictions of unitary models, non-cooperative models, collective models and bargaining models with regard to cooperation on pension take-up.

#### *The Unitary Model*

The crucial assumption in the unitary approach is that the household pool their resources to maximize a social welfare function. Another crucial assumption is that the Pareto-weights measuring the relative importance of the household members' preferences are constant. The utility function being maximized is therefore, by definition, independent of the distribution of income, and so are the resulting demands for private and public goods.

An implication of these assumptions is that if the household is concerned

with maximizing expected income, the couple will coordinate in claiming pension benefits. The couple will choose to delay person  $a$ 's pension take-up if person  $b$ 's income is sufficiently high to finance their current consumption.

### *The Non-Cooperative Model with Egotistic Preferences*

In the non-cooperative models there is, by assumption, no cooperation. I will still investigate whether being in a couple may facilitate delaying pension take-up. Consider first a non-cooperative model in which there is no public good. Each person has egotistic preferences and maximizes his or her utility, defined solely over private consumption, subject to the individual budget constraint. In this case, when there is no interdependence in preferences, no public good and no possibility to make binding agreements, being in a couple will not facilitate a delay.

When we introduce the public good, the analysis changes and the model makes less clear predictions. Both persons maximize their own utility, taking the other person's contribution to the public good as given. We know that this maximization problem has one Nash equilibrium, which can take two forms: one in which both persons contribute to the public good, and one in which only one person contributes to the purchase of the public good. Since both persons have egotistic preferences by assumption, neither of them will provide the other person with any positive amount of the private good.

We are concerned with this model's predictions when the income stream of person  $a$  ceases. There are three equilibria to consider: first, both persons contribute to the purchase of the public good; second, only person  $b$  contributes to the public good; and third, only person  $a$  contributes to the purchase of the public good.

First, when both persons contribute to the purchase of the public good, the demands for the public and private goods are independent of the distribution of income, i.e., the income pooling hypothesis holds. We know that for both persons to contribute to the purchase of the public good, each person's income, as share of household income, must be sufficiently high. What is "sufficiently high" depends on the preferences of the individuals. If the income stream of person  $a$  ceases, her share of household income will be relatively smaller, and the equilibrium in which both persons contribute to the purchase of the public good will break down. The couple will then move to the second equilibrium.

The second equilibrium is the one in which only person  $b$  contributes to the



purchase of the public good. From person  $b$ 's reaction function we know that:

1. If person  $a$  does not contribute, person  $b$  will supply  $\frac{(1-\beta)Y^b}{P}$ .
2. In order to make person  $a$  not contribute, person  $b$  must supply an amount greater than or equal to  $\frac{(1-\alpha)Y^a}{\alpha P}$ .

We are considering a case where person  $a$  is evaluating whether to delay pension take-up or not. For this second possibility to be an equilibrium, person  $b$  must provide a sufficiently large amount of the public good. What is a sufficiently large amount depends on preferences, but we can state the following:

- When  $\alpha$  decreases, i.e., person  $a$ 's relative preference for the public good increases, the amount person  $b$  must provide of the public good in order to make person  $a$  not contribute increases.<sup>32</sup>
- Person  $b$ 's income must be sufficiently high and / or her preferences for the public good must be sufficiently high, so that  $(1 - \beta)Y^b > \frac{(1-\alpha)Y^a}{\alpha}$ .
- Person  $a$  must have strong preferences for the public good, since person  $b$  never will provide her with any positive amount of the private good.

If these assumptions hold, person  $a$  can delay pension take-up and use previous savings to purchase small amounts of the private good, while person  $b$  is the sole contributor to the purchase of the public good. Person  $a$  is then a "free-rider": she benefits from person  $b$ 's provision of the public good, without contributing herself.

The third equilibrium is one in which only person  $a$  contributes to the purchase of the public good. If person  $a$  delays pension take-up, her share of household income will, by assumption, be too small for this to be an equilibrium.

In the non-cooperative model there is no cooperation, and the individuals maximize their own utility subject to the budget constraint. I have argued, however, that under some assumptions it is possible for person  $a$  to benefit from being member of a household and delay pension take-up. For this to be the case, person  $b$ 's income must be sufficiently high and / or her preferences for the public good must be sufficiently high. Person  $a$  must also have strong preferences for the public good, since person  $b$  never will provide her with any positive amount of the private good. If these assumptions do not hold, it is not possible for person  $a$  to delay pension take-up in this model.

---

<sup>32</sup>If we differentiate the expression in (2) with respect to  $\alpha$  we get:  $\frac{d}{d\alpha} = -\frac{Y^a}{\alpha^2 P} < 0$ .

When we allow for altruism in the non-cooperative model the analysis changes. In particular, if person  $b$  has interdependent preferences and cares about the private consumption of person  $a$ , the assumptions under which the second possibility is an equilibrium are relaxed. This is because person  $b$  may now choose to transfer money to  $a$  since her income is low.

### *The Collective Model*

Collective models are based on the assumption that, by allowing the couple to cooperate and communicate, the members will reach a Pareto-efficient allocation. Since the outcome, by assumption, is Pareto-efficient we expect that the couple will cooperate on claiming pension benefits. Although we assumed that both members have egotistic preferences, defined solely over their own consumption of the private and the public good, they can now make binding and enforceable agreements to maximize household income, from which they both may benefit.

In the collective model individual incomes matter for choices when the relative income shares affect the sharing rule, perhaps by affecting bargaining power (Ermisch, 2003: 29). According to Ermisch (2003), we expect heterogeneity in preferences to produce differences among households in whether joint household income or individual income determine the demands for private and public goods. This is the case even if the members of the couple have the same preferences, because each person's private consumption is affected.

This complicates the analysis. An implicit assumption in this model is that the household pools their resources and divide the pool according to a sharing rule. If the sharing rule is determined by relative income shares in each time period, person  $a$ 's bargaining power will be significantly reduced while she delays pension take-up. Later, when she claims pension benefits, she will have more bargaining power compared to if she claims benefits right away. In this case, the outcome may depend on both persons' subjective discount factor. If person  $a$  has strong preferences for current consumption, she may be reluctant to delay pension take-up if the sharing rule is determined by relative income shares in each period. Similarly, person  $b$  may be reluctant to coordinate if he has relatively stronger preferences for future consumption and his bargaining power in the future is reduced as a consequence of person  $a$  delaying pension take-up.

The analysis changes if the sharing rule takes into account the expected future increase in person  $a$ 's income. In these models the couple can make binding and enforceable agreements, so this is perhaps a more likely scenario in this model.

After all, the collective models are based on the assumption that the household will reach a Pareto-efficient allocation: in these models no resources are left on the table.

### *The Cooperative Bargaining Model*

With regard to the pension take-up decision in the cooperative bargaining model, the determinants of the threat points are especially important. The threat points may be external to the marriage, as in divorce-threat bargaining models, or internal to the marriage, like in the private spheres bargaining model of Lundberg and Pollak (1993).

An external threat point is the maximal level of utility attainable outside marriage. Examples of factors that influence an external threat point are competition in the marriage market, individual characteristics and income available to divorced women and men (Lundberg and Pollak, 1996). An internal threat point, on the other hand, is the utility associated with an inefficient equilibrium in which the couple no longer cooperates. It is reasonable to assume that the distribution of income is an important determinant of the internal threat points: if cooperation breaks down, each person uses his or her own income to finance private consumption and make voluntary contributions to the purchase of the public good.

In both collective models and cooperative bargaining models the notion of bargaining power is important. Unlike the collective models, the cooperative bargaining models, however, do not assume that the allocation agreed upon necessarily is Pareto-efficient. With regard to person  $a$ 's pension take-up decision, the predictions of the cooperative bargaining model are not obvious. On the one hand, delaying person  $a$ 's pension take-up increases expected household income and the pool to be divided. This is an argument in favour of cooperation. On the other hand, if person  $a$  delays claiming, both her utility attainable outside marriage and her utility associated with an inefficient internal equilibrium will increase in the future. This means that her bargaining power will increase. If the latter of the two effects dominate, person  $b$  may be reluctant to cooperate, even though the delay will increase the expected pool to be divided.

Some cooperative bargaining models rest on the assumption that the couples can make binding agreements. In this case, we expect the couple to agree upon a Pareto-efficient allocation.

### *Summary*

The models presented make different predictions with regard to cooperation on the claiming of pension benefits. These predictions can be summarized as follows:

- According to the unitary model, the couple will indeed cooperate. An underlying assumption of the unitary model is that the household maximizes a household utility function subject to a household budget constraint.
- In the collective model individual incomes matter for choices when the relative income shares affect the sharing rule. An underlying assumption of the model is, however, that the couple can make binding and enforceable agreements. We therefore expect them to reach a Pareto-efficient agreement.
- If there is no public good, the prediction of the non-cooperative model is that being in a couple do not facilitate delaying pension take-up.
- If there is a public good, the prediction of the non-cooperative model is that being in a couple may, under circumstances, facilitate delaying pension take-up. For this to be the case, the partner's income must be sufficiently high, and both persons must sufficiently favour the public good. If these assumptions are not satisfied, being in a couple does not facilitate the take-up.
- The cooperative bargaining model makes no clear prediction. On the one hand, delaying person  $a$ 's pension take-up increases expected household income and the pool to be divided. On the other hand, delaying pension take-up will increase the value of his outside options, and increase his bargaining power. Person  $b$  may be reluctant to cooperate if the latter effect dominates.

The models make predictions with regard to what we should expect from the empirical investigation in chapter 5. According to the unitary model and the collective model we should expect that the couples coordinate on the claiming of pension benefits. The non-cooperative model, by assumption, predicts that the members will not cooperate. If the partner's income is sufficiently high and if both members sufficiently favours the public good, being in a couple may however facilitate delaying pension take-up. The cooperative bargaining model makes less clear predictions.

## 4.5 Existing Empirical Findings

Due to the complexity of its topic, this thesis relates to various strands of the existing empirical literature. This section provides an overview of some empirical findings, but the overview is by no means exhaustive. Two types of studies will be presented. First, previous studies of couples and the claiming of Social Security benefits, and secondly, previous studies on the degree of income pooling in the household.

### Couples and the Take-Up Decision

The existing studies of couples and claiming behaviour that I am aware of, investigate the take-up of Social Security benefits. These existing empirical findings are relevant for this thesis since the Norwegian pension scheme and the Social Security programme are characterized by similar rules. A key feature of both the Norwegian and the American system is that retirement need not be concurrent with claiming of benefits. In the U.S., workers can claim Social Security benefits in the age range 62 - 70. The pension scheme is actuarial neutral on average, meaning that the present value of expected lifetime Social Security benefits for an individual with average life expectancy is the same, regardless of the timing of pension take-up. In contrast to the Norwegian pension scheme, there is means testing.<sup>33</sup> For married couples there are also spouse and survivor benefits. If a member of the couple has a low earning's history he or she may be entitled to a spouse benefit which equals half of the partner's benefit. In addition to the spouse benefit, a survivor benefit is paid when the primary earner of the household dies. The survivor benefit is equal to the benefit received by the deceased when he or she was alive. Total lifetime benefits the household will receive are affected by the primary earner's claim age, because retired worker and dependent benefits both vary with the actuarial adjustments applied to monthly benefits (Henriques, 2012). A major difference between Norway and the U.S. with regard to benefit take-up is that a majority of American women receive most of their Social Security benefits based upon their husbands' earnings history.

The notion that the present value of Social Security benefits is the same regardless of the timing of benefit take-up is valid for workers with average expected longevity. Since individuals have differing expected longevity, the Social Security scheme is, like the Norwegian pension scheme, potentially exposed to

---

<sup>33</sup>If the earnings of an individual who has claimed Social Security benefits are above a certain threshold, his benefits will be reduced.

problems of adverse selection and moral hazard.<sup>34</sup> A common feature of the studies presented below is the use of the present value of expected benefits as a measure of Social Security wealth at different claiming ages to explain the timing of benefits take-up.

Coile et al. (2002) use data from the 1982 New Beneficiary Survey and analyze the claiming of Social Security benefit of single and married men, who retired before they turned 62. They calculate the net present value of future benefit streams for a single worker and for a married couple and use these calculations to examine the variation in incentives for claiming delays among subgroups of the population.<sup>35</sup> When calculating the net present value of future benefit streams for a married couple, Coile et al. (2002) considers a one-earner couple and implicitly assume that the husbands consider the incentives from his own benefit and any benefit received by his spouse equally when deciding when to claim.<sup>36</sup> They argue that under a wide variety of circumstances, delayed claiming is optimal, and that the gains of delaying benefit take-up can be quite substantial. In particular the incentive to delay is stronger if the claimant has a longer life expectancy, and married men generally have a stronger incentive to delay claiming than do single men, due to the spouse and survivor benefits.

The authors' main finding is that the majority of men in the sample claimed pension benefits as soon as they became eligible. A substantial minority did, however, delay benefit take-up. Investigating this subgroup, the authors found that men with longer life expectancies have longer delays. Coile et al. (2002) did not, however, find support for the hypothesis that married men have longer delays than single men. In addition, the average delay was relatively short and far less prevalent than theory would predict. The study also identified household wealth as a determinant of claiming age, with both rich and poor households claiming relatively early. According to Coile et al. (2002) this reflects impatience and / or liquidity constraints at low wealth levels, and a strong bequest motive at high wealth levels.

Hurd et al. (2004) use data from the Health and Retirement Study to examine the relationship between mortality risk and retirement, and mortality risk and

---

<sup>34</sup>Davies and Kuhn (1992) develop a theoretical framework to study the effects of social security when individuals can take *hidden actions* to affect their longevity.

<sup>35</sup>Another technique used by Coile et al. (2002) is expected liquidity maximization under liquidity constraints. This approach has the advantage of capturing the insurance value of Social Security. Due to computational complexity, the expected maximization model is calculated for single workers only.

<sup>36</sup>This means that the unitary model is assumed implicitly.

the propensity to take early, reduced Social Security benefits. They find that individuals with low subjective probabilities of survival retire earlier and claim earlier than those with higher subjective probabilities. These effects are not large, and the great majority of workers claim as soon as they are eligible. Also Hurd et al. (2004) emphasize that married workers have a greater financial benefit to delay the take-up of Social Security benefits than single workers, since the surviving spouse can inherit the benefit of the retired worker. This effectively increases the life expectancy of the couple. The authors find that married workers do delay claiming: being married leads to about 1.1 month delay in claiming. Like Coile et al. (2002), Hurd et al. (2004) found that agents claim much earlier than the ages that would maximize the households' Social Security wealth. The high levels of early claiming, they argue, is a major puzzle.

The study of Henriques (2012) is concerned with how individuals respond to the different incentives in the Social Security scheme. According to the studies of Coile et al. (2002) and Hurd et al. (2004), American men claim earlier than the age that would maximize the households' net present value of future benefits. By focusing on household incentives, it is implicitly assumed that the primary earner takes all household benefits into consideration when making the claiming decision. Such an approach assumes that the primary earner is indifferent between the types of benefits received by the household over all points in time, regardless of whether he or she is alive when the benefits are received. This assumption is not unproblematic: it is possible that individuals respond differently to three different types of incentives built into the Social Security scheme. Early benefit take-up by a married man has three implications. First, his pension benefits will be reduced through the actuarial adjustment; secondly, the spouse benefit will be reduced; and third, the survivor benefit will be reduced. Henriques (2012) shows that there is a positive relationship between husbands' claiming behaviour and the actuarial incentives built into the retired worker benefit formula. Empirical evidence do not, however, indicate that claiming behaviour responds to incentives from either total household benefits or the dependent benefits paid to wives in any significant way.

Sass et al. (2007) point out that these existing empirical findings on Social Security benefit take-up are in contrast with economic theory. That most married American men claim Social Security benefits at age 62 or 63, which is earlier than the age that maximizes the household's expected present value of benefits, is not in accordance with the unitary model nor cooperative bargaining mod-

els.<sup>37</sup> Sass et al. (2007) found that the general pattern of early pension take-up by married men (1) leaves Social Security wealth "on the table"; (2) sharply reduces benefit receipt at a time when only the wife is likely to be alive, and (3) significantly increase the risk that the wife will face hardship should she become a widow. The authors consider two variables that could lead to such early claiming: ignorance and household decision-making. A question is whether individuals truly understand the incentives built into the Social Security scheme, or whether caddishness could lead husbands to claim early. In doing this, they control for factors that have been identified to influence claiming behaviour - expected longevity and household wealth.

In the sample studied by Sass et al. (2007) the only statistically significant characteristic differentiating later from early claimers is higher education. The authors interpret the relationship between education and delayed claiming as the effect of greater financial awareness.<sup>38</sup> In particular, they do not find empirical evidence indicating that early claimers are more caddish than individuals who delay benefit take-up. The study concludes by stating that social convention is the primary explanation of sub-optimal claiming behaviour, and that financial awareness is the primary corrective. Sass et al. (2007) argue that this is in line with the broader household bargaining literature, which emphasizes the importance of social convention in influencing outcomes.<sup>39</sup>

Munnell and Soto (2005) points out that in particular women, who on average have longer life expectancy than men, would gain from delaying the take-up of Social Security benefits. They point out that women, even more than men, tend to claim Social Security benefits as soon as they become eligible. To find the key to this puzzle, the authors study the claiming patterns of men and women by marital status. Munnell and Soto (2005) observe that a significantly smaller percentage of single women claim benefits early than either married or single men. This, they argue, makes sense since women on average live longer than the "break-even" age, which means that they will enjoy the higher benefits they get from postponing pension take-up for enough additional years to more than compensate for the pension benefits forfeited. Married women, on the other

---

<sup>37</sup>Sass et al. (2007) argue that according to cooperative bargaining models, the couple will maximize household surplus. The husband might, however, claim early if the wife is unable to offer an appropriate compensation of delayed claiming.

<sup>38</sup>The authors do not, however, find any statistically significant relationship between the age of claiming and their measure of financial literacy.

<sup>39</sup>The authors emphasizes that due to the small sample size and limited variance in the dependent variable the results must be viewed as extremely tentative.



hand, are more likely to claim benefits early than single and married men.

The authors emphasize that single women and married women face very different choices. The reason is that married women are entitled to three types of benefits: a benefit based on their own earnings record; a spouse benefit equal to 50 percent of their husband's benefit if that exceeds their own benefit; and a survivor's benefit. From the wife's perspective, claiming age does not affect the survivor's benefit. This means that the decision over which the wife has control is when to claim the benefits she receives until the death of her husband. The relevant life expectancy is therefore that of her husband. Since these benefits are expected to be received for a period shorter than the life expectancy of the average person, the wife has an incentive to claim early.

### **The Income Pooling Hypothesis**

Among the economic models of household behaviour the unitary model, in particular, makes very clear predictions that can be tested empirically. Its main prediction is that household demands for various goods are independent of the distribution of income. This property is sometimes present in non-unitary models as well, but it is then a local property. A rejection of the income pooling hypothesis is therefore tantamount to a rejection of the unitary model. There are several studies investigating whether the distribution of income within the household makes a difference to household demands.

Using survey data on family health and nutrition in Brazil, Thomas (1990) finds that households' demand are not independent of the distribution of income. The study shows that non-wage income in the hands of the mother has a bigger impact on the family's health than income attributed to the father. For child survival probabilities, the effect is almost 20 times bigger. The income pooling hypothesis is therefore rejected by Thomas (1990).

Bourguignon et al. (1993) test whether the income pooling hypothesis can be accepted for French consumption data. This is done by testing whether the coefficients of the various components of family income - earnings of both members and property or transfer income - are significantly different in explaining the total expenditures of various consumption goods. The authors find that for a given level of total income, the share of husband's and wife's own income significantly affects the structure of consumption. The income pooling hypothesis is therefore rejected.

Also the study by Lundberg et al. (1997) rejects the income pooling hypoth-

esis. The authors use a policy change in the United Kingdom that transferred a substantial child allowance to wives in the late 1970s. Using Family Expenditure Survey data Lundberg et al. (1997) find that a shift toward greater expenditures on women's clothing and children's clothing relative to men's clothing coincided with this income redistribution. This, they argue, indicates that the distribution of income matters for household demands' for various goods.

Phipps and Burton (1998) use microdata from the 1992 Statistics Canada Expenditure Survey to provide evidence that male and female incomes do not always exert identical influence on household expenditures. They find, however, that incomes may be pooled for some categories of consumption (e.g. housing) while the income pooling hypothesis must be rejected for others.

Overall, empirical evidence suggest that the distribution of income matter for household demands. While these empirical studies reject the income pooling hypothesis, it is important to emphasize that they do not reject that hypothesis that couples pool their resources and cooperate to maximize household income.

## 5 Data and Empirical Findings

This chapter is outlined as follows. The first section provides a description of the data set that I will use for the empirical analysis and a description of aggregate claiming behaviour and retirement in 2011. I will also explain how Brinch et al. (2013) estimate expected longevity for the Norwegian cohort of 1949 within the framework of the microsimulation model MOSART, and how the authors use these estimates to calculate the *relative money's worth* (RMW) of delaying pension take-up from age 62 to 67 for each individual. In the second section I investigate how own income and wealth, partner's income and the RMW of delaying pension take-up can explain the choice to retire without claiming old age pension benefits. In the third section I investigate the pension take-up by couples where both members were born in 1949 and eligible for early pension take-up in 2011. I use the RMW of delaying pension take-up for both members in two different ways to estimate the probability of only one of the members claiming old age pension benefits. At last, I investigate whether empirical evidence suggest that the individuals in the latter sample understand the incentives in the pension scheme.

### 5.1 The Data Set

When the pension reform was implemented in January 2011, a large number of individuals aged 62 - 66 became eligible for early pension take-up. Like Brinch et al. (2013) I will focus on the group of Norwegian citizens who became eligible for pension take-up throughout 2011 by turning 62 years. The new pension take-up rules were implemented in January 2011, but already in December 2004 the Norwegian government issued a White Paper setting out a strategy for the new pension scheme (Stortingsmelding nr. 12 2004 - 2005, 2004). The new pension rules were therefore anticipated, and the larger 62 - 66 years sample is therefore self-selected in a complicated way. In short, a large subgroup of these individuals had the opportunity to take up the old early retirement scheme in 2010 or earlier. In addition, they had the opportunity to evaluate whether it would be beneficial for them to take up the old system or wait until January 2011 and take up the new flexible pension. The advantage of using the smaller sample of 62 year-olds is that this subgroup was never exposed to the old retirement scheme. In this regard they are also representative for later birth cohorts.

The starting point for my analysis is therefore all Norwegian citizens born be-

tween January and November 1949 and eligible for early pension take up during 2011; 23 409 individuals.<sup>40</sup> For these individuals I have data from the Directory of Taxes' LTO-register on annual incomes in 2010 and 2011.<sup>41</sup> Further, I have administrative register data on wealth, marital status, partner's income, education and pension take-up in 2011. With regard to marital status I am concerned with whether an individual is married, registered with a partner or living as a cohabitant. If a person is non of the above, I consider him or her as single.

Like in Brinch et al. (2013), an individual is considered retired if he is registered as retired in the employer/employee register or if his annual income is reduced by a certain relative amount from 2010 to 2011.<sup>42</sup> By evaluating retirement in terms of reduced income it is possible that individuals who retired partially are defined as retired. Since data from the LTO-register are used to evaluate retirement, individuals who are self-employed are excluded from the sample.<sup>43</sup> This leaves a sample of 17 020 individuals. Table 2 provides a description of aggregate claiming and retirement behaviour for this group in 2011.

Table 2: Aggregate claiming and retirement behaviour of 17 020 individuals eligible for early pension take-up in 2011, employed in private sector or public sector firms.

	Retired		Not Retired		Total	
<i>All</i>						
Not claiming	1 964	(11.5 %)	9 789	(57.5 %)	11 753	(69.0 %)
Claiming	1 511	(8.9 %)	3 756	(22.1 %)	5 267	(31.0 %)
Total	3 475	(20.4 %)	13 545	(79.6 %)	17 020	(100.0 %)
<i>Working in private sector firm</i>						
Not claiming	990	(11.5 %)	4 896	(48.1 %)	5 886	(57.8 %)
Claiming	1 346	(13.2 %)	2 948	(28.9 %)	4 294	(42.1 %)
Total	2 336	(22.9 %)	7 844	(77 %)	10 180	(100.0 %)
<i>Working in public sector firm</i>						
Not claiming	974	(14.2 %)	4 893	(71.5 %)	5 867	(85.8 %)
Claiming	165	(2.4 %)	808	(11.8 %)	973	(14.2 %)
Total	1 139	(16.7 %)	5 701	(83.3 %)	6 840	(100.0 %)

<sup>40</sup>Individuals born in December 1949 were not eligible for claiming pensions until January 2012.

<sup>41</sup>Skattedirektoratets Lønns- og trekkoppgaveregister in Norwegian.

<sup>42</sup>The employer / employee register is the English translation of Arbeidsgiver- og arbeidstakerregisteret.

<sup>43</sup>Individuals who are self-employed report their incomes the year after.

The data on aggregate behaviour shows that the correlation between retirement from the labour force and the claiming of old age pensions is far from perfect. These findings indicate that individuals make separate decisions of whether to retire from the labour market and claim old age pensions. Table 3 provides some descriptive statistics.

Table 3: Descriptive Statistics of 17 020 individuals eligible for early pension take-up in 2011, employed in private sector or public sector firms.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Expected longevity	17 020	86.604	2.1522	76.163	92.587
RMW	17 020	1.0400	0.0253	0.8881	1.1547
Male	17 020	0.733	0.4426	0	1
Couple	17 020	0.811	0.3913	0	1
Variable (2010)	Obs.	Median	Std. Dev.		
Labour income	17 020	526 989	304 986		
Wealth	17 020	464 755	3 733 538		
Partner's lab. income	13 744	333 970	272 100		

### The Relative Money's Worth of Delaying Pension Take-Up

The actuarial adjustments in the pension system are based on average mortality risks for a cohort, and do not vary over individuals. For each individual, it therefore makes sense to think about the money's worth of the implicit annuity of delaying take-up as a function of their expected longevity. When studying annuity demand the relevant measure of mortality risk is the individuals' subjective expectations. In absence of data on subjective expectations, a good approximation is to use the expected longevity based on observable characteristics. It is reasonable to expect that these variables are correlated if individuals form their subjective expectations in a rational way.<sup>44</sup>

In their study of adverse selection in the Norwegian pension scheme, Brinch et al. (2013) estimate the expected longevity for all Norwegian citizens born in 1949, alive in 2011 and eligible for early pension take-up during 2011. They do this in two steps. First, the authors estimate a mortality model on the full Norwegian population in the years 2001 - 2010. Among the explanatory variables

<sup>44</sup>For a discussion of subjective expectations and expected longevity, see for example Hurd and McGarry (1995).

in the mortality model are education, disability status, civil status and parents' longevity. Separate mortality models are estimated for women and men.

The second step is to use the estimated mortality model to predict expected longevity for the Norwegian birth cohort of 1949. Within the framework of the MOSART microsimulation model, the mortality model is simulated 900 times for each individual of the actual Norwegian birth cohort of 1949. The expected longevity for each individual is calculated as the average of the simulated results.

Brinch et al. (2013) use the estimated expected longevity to calculate the *relative money's worth* (RMW) of delaying pension take-up from age 62 to 67. The authors define this measure in the following way:

$$RMW = \frac{E \left( \sum_{a=67}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{67} \right)}{E \left( \sum_{a=62}^{\infty} \frac{s_a}{(1+r)^{a-62}} A_a^{62} \right)} \quad (24)$$

where  $A_a^{62}$  and  $A_a^{67}$  denote the income stream at age  $a$  conditional on claiming pensions at age 62 and 67 respectively,  $s_a$  is the probability of surviving age  $a$ , and  $r$  is the discount rate. The numerator is the expected stream of future pension benefits if the individual claims benefits at age 67, while the denominator is the expected stream of future pension benefits if the agent claims at age 62.

Delaying pension take-up increases expected lifetime income if  $RMW > 1$ . In order to calculate the RMW it is, however, necessary to make assumptions about the discount rate. The cutoff of who will gain from and who will lose from delaying pension take-up will therefore vary for different values of the discount rate. The absolute levels of the RMW for the individuals are not so important for the empirical analysis in this chapter. What is important in the regressions is rather the deviation in individuals' RMW from the mean RMW. This is much more robust to assumptions about average longevity and discount rates than the absolute levels.

## 5.2 Retiring without Claiming Pension Benefits

In this section I will investigate whether partner's income can explain the choice to retire without claiming old age pension benefits. It is reasonable to assume that the decision to retire without claiming old age pension benefits is determined by own income, partner's income, wealth and the RMW of delaying pension take-up. If own income and wealth are high, an individual is less likely to be liquidity constrained. If partner's income is high, this may facilitate retiring from the labour force without claiming old age pension benefits. Ultimately, we expect the decision to retire without claiming benefits to depend on the RMW of delaying pension take-up. While own income, wealth and partner's income may relax liquidity constraints, we expect the RMW to be the variable motivating the decision: one can hardly think of any other reason underlying the decision to retire without claiming benefits if not because of some financial gain.

It is not possible to receive public sector contractual early retirement pension and pension from the National Insurance Scheme at the same time. This means that individuals who retire from the public sector lose their contractual pension rights if they claim pension benefits from the National Insurance Scheme. I will therefore exclude employees in the public sector in this analysis. This reduces the number of observations from 17 020 to 10 180. Since I am concerned with economic cooperation in the household, I will also exclude single individuals from the sample. This reduces the number of observations from 10 180 to 8 458 individuals. Table 4 provides a description of aggregate claiming and retirement for this group in 2011.

Table 4: Aggregate claiming and retirement of 8 458 individuals who were born in 1949, employed in the private sector, member of a couple and eligible for early pension take-up in 2011.

	Retired		Not Retired		Total	
<b>Not claiming</b>	808	(9.5 %)	4 007	(47.4 %)	4 815	(56.9 %)
<b>Claiming</b>	1 128	(13.3 %)	2 515	(29.7 %)	3 643	(43.1 %)
<b>Total</b>	1 936	(22.9 %)	6 522	(77.1 %)	8 458	(100.0 %)

We notice that for the majority, 60.7 %, the decision to retire and the decision to claim old age pension benefits appear to be the same decision. 47.4 % did not retire nor claim old age pension benefits, while 13.3 % retired and claimed pension benefits. For a significant number of individuals, however, the timing of

retirement and the timing of benefit take-up did not coincide. 29.7 % claimed benefits without retiring, while 9.5 % retired without claiming old age pension benefits. This observation confirms that the decision to retire and the decision to claim pension benefits are indeed decoupled. Table 5 provides some descriptive statistics of the sample.

Table 5: Descriptive Statistics of 8 458 individuals born in 1949, eligible for early pension take-up in 2011, member of a couple, employed in private sector or public sector firms.

<b>Variable</b>	<b>Obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
Expected longevity	8 458	86.285	1.6693	76.662	92.274
RMW	8 458	1.0352	0.0204	0.9064	1.1547
Male	8 458	0.859	0.3481	0	1
<b>Variable (2010)</b>	<b>Obs.</b>	<b>Median</b>	<b>Std. Dev.</b>		
Labour income	8 458	521 372	356 155		
Wealth	8 458	495 914	4 571 330		
Partner's lab. income	8 436	306 241	241 037		

While individuals who retire before they claim old age pension benefits may be liquidity constrained, this is not a relevant problem for individuals who claim old age pension benefits before they retire. Since I am concerned with economic cooperation in the household, I will therefore investigate the decision to retire from the labour force without claiming old age pension benefits.

In this section I will estimate two linear probability models. In the first model, the dependent variable is a dummy variable taking the value 1 if an individual retired without claiming benefits. I will estimate the model on the sample of individuals who were born in 1949, members of a couple, eligible for early pension take-up in 2011 and employed in the private sector ( $N = 8\,458$ ).

In the second model the dependent variable is a dummy variable taking the value 1 if an individual did not claim pension benefits. This model is estimated using a subsample of the 10 180 observations, namely the individuals who were born in 1949, members of a couple, eligible for early pension take-up in 2011, employed in the private sector and who retired in 2011 ( $N = 1\,936$ ).



## The Regressors

I use the individual's own income ( $Y$ ) and wealth ( $W$ ), partner's income ( $PY$ ) and the relative money's worth ( $RMW$ ) of delaying the pension take-up from age 62 to 67 as regressors to estimate two linear probability models.

I do not use the absolute level of income as a regressor. Instead I create dummy variables for each quartile of income, using the lower quartile as the reference value. The dummy variable  $Y(2)_i$  takes the value 1 if individual  $i$  is in the second quartile or above, and 0 otherwise. Similarly,  $Y(3)_i$  takes the value 1 if individual  $i$  is in the third quartile or above, and 0 otherwise. Finally,  $Y(4)_i$  takes the value 1 if individual  $i$  is in the upper quartile, and 0 otherwise. I create similar dummy variables for wealth and partner's income.

The regression equations I want to estimate are of the following form:

$$\begin{aligned} Z_i = & \alpha_0 + \alpha_1 \cdot Y(2)_i + \alpha_3 \cdot Y(3)_i + \alpha_4 \cdot Y(4)_i + \alpha_5 \cdot W(2)_i \\ & + \alpha_6 \cdot W(3)_i + \alpha_7 \cdot W(4)_i + \alpha_8 \cdot PY(2)_i + \alpha_9 \cdot PY(3)_i \\ & + \alpha_{10} \cdot PY(4)_i + \alpha_{11} \cdot RMW_i + e_i \end{aligned} \quad (25)$$

## The Probability of Retiring without Claiming Benefits

In the first regression the the dependent variable is a dummy variable taking the value 1 if an individual retired without claiming benefits. I run the regression using all observations in the sample ( $N = 8\,458$ ). The regression results are reported in Appendix B. Stata automatically tests the model's overall significance by conducting an F-test. The reported p-value is 0.0011, so we reject the null hypothesis that all coefficients are zero with high confidence.

In the estimated model, the dummy variable indicating whether an individual is in the upper quartile of the income distribution is the only significant variable.<sup>45</sup> The estimated coefficient is 0.0371, meaning that as an individual moves from the third to the upper quartile of the income distribution, the probability of retiring without claiming pension benefits increases by 3.7 percentage points.

None of the coefficients for partner's income or wealth are significantly different from zero. Nor is the coefficient of the RMW of delaying pension take-up. We also note that the coefficient of the RMW has the opposite sign of what we would expect.

---

<sup>45</sup>For each estimated coefficient, Stata automatically conducts a two-sided t-test, testing the null hypothesis that the coefficient is zero against the alternative hypothesis that the estimated coefficient is different from zero.

The estimated coefficient for moving from the first to the second quartile of the income distribution is not significant. Nor is the estimated coefficient for moving from the the second to the third quartile of the income distribution. To test whether income is a significant variable, I test the joint hypothesis  $H_0 : \alpha_1 = \alpha_2 = \alpha_3 = 0$ , against the alternative hypothesis  $H_1 :$  At least one of the coefficients are non-zero. I reject the null hypothesis at  $\alpha = 0.05$  and conclude that at least one of the coefficients are non-zero.<sup>46</sup>

The estimated result is a puzzle. One would expect the decision to retire without claiming pension benefits to be a strategic decision aimed at maximizing the expected stream of pension benefits. Empirical evidence suggests on the other hand that the RMW of delaying pension take-up is not significant with regard to the probability of making this decision. In addition, empirical evidence suggests that individuals in the upper quartile are more prone to retire without claiming pension benefits. If individuals belonging to the upper quartile of the income distribution in 2010 have had relatively high earnings throughout their working career, these individuals also have a higher than average pension wealth. This means that in terms of pension benefits forfeited, these individuals pay a higher price for delaying pension take-up than individuals with a lower pension wealth.

The probability model is estimated on a sample of individuals who choose between four different combinations of claiming and retirement. The retirement decision and the decision to claim pension benefits may, however, be simultaneous decisions. Some of the regressors may influence both the retirement decision and the take-up decision, and produce effects that work in opposite directions and cancel out. The estimated result should therefore be interpreted with caution.

## Regression Results Using a Restricted Sample

In the second regression the dependent variable is a dummy variable taking the value 1 if an individual did not claim pension benefits. This model is estimated using a subsample of the 8 458 observations, namely the individuals who were born in 1949, eligible for early pension take-up in 2011, employed in the private sector and who retired in 2011 ( $N = 2\,336$ ). The regression results are reported in Appendix D.

When estimating this linear probability model, it is tempting to interpret the left hand side as the probability of not claiming benefits, given that an individual has retired. For the vast majority, however, the take-up decision and

---

<sup>46</sup>See Appendix C for calculations.

the retirement decision coincide.<sup>47</sup> An individual who would like to retire and not claim benefits may be liquidity constrained, and therefore choose not to retire. Since the decision to retire and decision to claim pension benefits may be simultaneous decisions, the estimated results must be interpreted with caution. Note, however, that Coile et al. (2002) and Hurd et al. (2004) use this approach to study delays in the claiming of Social Security benefits.

The reported p-value of the model's overall significance is 0.0000, so we reject the null hypothesis that all coefficients are zero with very high confidence. In the estimated model there are three significant coefficients: the coefficients for the upper quartile of income, the upper quartile of wealth and the RMW of delaying. Partner's income is not significant at any relevant level of significance.

The dummy variable indicating whether an individual is in the upper quartile of the wealth distribution is significant at  $\alpha = 0.05$ . The estimated coefficient is 0.0638, meaning that as an individual moves from the third to the upper quartile of the wealth distribution, the probability of not claiming pension benefits increases by 6.4 percentage points. The regressor is the individual's registered wealth. Often, however, the wealth registered on the members of the couple is the same. Wealth is also highly correlated with own labour income and partner's labour income.

The RMW of delaying is significant at  $\alpha = 0.001$ . The estimated coefficient is 2.001, meaning that if the RMW of delaying increases by, say 0.01, the probability of not claiming increases by 2 percentage points. If individuals are concerned with maximizing expected lifetime income, this is precisely what we would expect. Given that the RMW varies from 0.91 to 1.15 in the sample, this effect is rather strong.

The dummy variable indicating whether an individual is in the upper quartile of the income distribution is significant at  $\alpha = 0.001$ . The estimated coefficient is 0.130, meaning that as an individual moves from the third to the upper quartile of the income distribution, the probability of not claiming pension benefits increases by 13 percentage points.

### Some Remarks

In the first regression I estimate a linear probability model where the dependent variable is a dummy variable taking the value 1 if the individual retired without claiming pension benefits. I estimate the model, using observations on a sample

---

<sup>47</sup>See table 3.

of 8 458 individuals who were born in 1949, eligible for early pension take-up in 2011, employed in the private sector and member of a couple. I find that the only significant variable is the dummy variable indicating whether an individual is in the upper quartile of the income distribution, and that moving from the third to the upper quartile of the income distribution increases the probability of retiring without claiming pension benefits by 3.7 percentage points. In particular, partner's income and the RMW of delaying pension take-up are not significant. These results suggest that individuals who are relatively rich are more prone to retire without claiming pension benefits, while this decision appears to be unaffected by partner's income and the RMW of delaying pension take-up.

In the second regression I estimate another linear probability model using a subsample of the observations, namely the individuals who did retire in 2011. Three coefficients are significant: the dummy variable indicating whether an individual is in the upper quartile of the income distribution, the dummy variable indicating whether an individual is in the upper quartile of the wealth distribution and the RMW of delaying pension take-up. The estimated result indicates that individuals who are relatively rich are more prone to delay claiming, and this effect is now stronger than in the first regression: as an individual moves from the third to the upper quartile of the income distribution, the probability of delaying pension take-up increases by 13 percentage points. Moving from the third to the upper quartile of the wealth distribution, the probability of delaying pension take-up increases by 6.4 percentage points. The RMW of delaying pension take-up is now significant, and as RMW increases the probability of delaying pension take-up increases. This is what we expect if individuals are concerned with maximizing lifetime benefits.

In both the estimated models own income is important. The RMW of delaying pension take-up is, however, not significant in the first model, while it is significant in the second model. Two possible explanations of differences in the significance of the RMW are the following: first, it is possible that the subsample of retired individuals are self-selected; and secondly, it is possible that some of the explanatory variables in the larger sample produce opposing effects on the retirement decision and the take-up decision.

### 5.3 Both Members of the Couple from the 1949-cohort

The second approach is to study couples where both members were born in 1949 and eligible for early pension take-up in 2011 ( $N = 404$ ). Since the number of such couples is relatively small, I will only investigate the take-up decision.<sup>48</sup>

Let  $C_W$  be a dummy variable taking the value 1 if the wife claimed pension benefits, and 0 otherwise, and let  $C_H$  be a dummy variable taking the value 1 if the husband claimed pension benefits and 0 otherwise.<sup>49</sup> The couples faced four possibilities with regard to the pension take-up in 2011: both claiming pension benefits ( $C_W = 1 \cap C_H = 1$ ), none of them claiming pension benefits ( $C_W = 0 \cap C_H = 0$ ), the wife not claiming pension benefits while the husband claimed ( $C_W = 0 \cap C_H = 1$ ), and the wife claiming pension benefits while the husband did not claim ( $C_W = 1 \cap C_H = 0$ ). Table 6 provides a description of the couples' pension take-up decisions, while table 7 provides some descriptive statistics.

Table 6: Pension take-up in 2011 by couples where both members were born in 1949

	Wife claimed ( $C_W = 1$ )	Wife did not claim ( $C_W = 0$ )	Total
Husband claimed ( $C_H = 1$ )	41	66	107
Husband did not claim ( $C_H = 0$ )	28	269	297
Total	69	335	404

In this section I estimate five linear probability models. In the first regression the dependent variable is a dummy variable which takes the value 1 if the wife claimed benefits while the husband did not. I estimate this model using observations on all couples where only one of the member claimed pension benefits ( $N = 94$ ), and using the difference in the relative money's worth of delaying pension take-up from age 62 to 67 for the wife and the husband as the sole regressor. If the couple is concerned with maximizing lifetime income, we expect that an increase in this difference reduces the probability of the wife claiming and the husband not claiming.

A dummy variable which takes the value 1 if the wife claimed benefits while

<sup>48</sup>It is not feasible to evaluate retirement for both partners in these couples. In order to evaluate retirement we would have to exclude self-employed and employees in the public sector, which would leave us with 58 couples only.

<sup>49</sup>The 404 couples are indeed heterosexual couples. I use, for simplicity, "wife" and "husband" although the couples consist of cohabiting couples as well.

Table 7: Descriptive Statistics of the members of of 404 couples in which both members were born in 1949 and eligible for pension take-up in 2011.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Expected longevity (H)	404	86.202	1.2438	80.598	88.733
Expected longevity (W)	404	89.733	1.2813	85.407	92.287
Husband's RMW	404	1.0362	0.0132	0.9706	1.0626
Wife's RMW	404	1.0772	0.0123	1.0392	1.1547
Difference in RMW	404	-0.0409	0.0163	-0.1202	0.0072

  

Variable (2010)	Obs.	Median	Std. Dev.
Husband's labour income	404	594 184	412.698
Wife's labour income	404	476 312	190 227
Wealth	404	651 633	1 708 781

the husband did not is the dependent variable in the second regression as well. In this regression, however, I use the relative money's worth of delaying pension take-up for the wife and the husband as two distinct explanatory variables, and I estimate the model using observations on all the couples ( $N = 404$ ). In the third regression the dependent variable is a dummy variable taking the value 1 if the husband claimed benefits while the wife did not. This model is estimated in the same way as the second regression.

At last I estimate two linear probability models to investigate whether empirical evidence suggests that the individuals in this sample respond to the incentives in the pension scheme. The findings of Brinch et al. (2013) suggests that the Norwegian pension scheme is plagued by adverse selection. I run these regressions to investigate whether the individuals in this sample behave according to these findings. The regression results are reported in Appendix E.

### The Difference in RMWs as Regressor

The dependent variable is a dummy variable taking the value 1 if the wife claimed benefits while the husband did not. I use observations on all couples where only one member claimed his or her pension benefits ( $N = 94$ ). If a couple uses available information and cooperate on economic decisions, we expect that the member whose relative money's worth of delaying the pension take-up is higher, delays the take-up.

Let  $RMW_{(W)}$  and  $RMW_{(H)}$  denote the relative money's worth of delaying

the pension take-up from age 62 to 67 for the wife and the husband respectively. If  $RMW_{(DIFF)} = RMW_{(W)} - RMW_{(H)} > 0$ , maximization of household lifetime income suggest that the husband claims early while the wife delays. If  $RMW_{(W)} - RMW_{(H)} < 0$ , financial maximization suggests that the wife claims early while the husband delays.

The estimated regression equation is:

$$\hat{P}_i(C_W = 1 \cap C_H = 0) = 0.409 - 2.613 \cdot RMW_{(DIFF)_i} \quad (26)$$

where  $\hat{P}_i(C_W = 1 \cap C_H = 0)$  is the estimated probability that the wife claimed pension benefits while the husband did not claim. The sign of the coefficient is negative, meaning that when the difference in RMW between delaying the wife's pension take-up and the husband's take-up increases, the probability of the wife claiming and not the husband is reduced. The estimated coefficient is -2.613, meaning that when  $RMW_{(DIFF)_i}$  increases by, say, 0.01,  $\hat{P}_i(C_W = 1 \cap C_H = 0)$  is reduced by 2.6 percentage points. This is in line with what we would expect in the case of economic cooperation: if only one member claims pension benefits, it is the member whose RMW of delaying is the highest who delays the take-up.

The coefficient is, however, not significant. The reported p-value is 0.416, so we do not reject the null-hypothesis that the coefficient is zero at any relevant level of significance. We conclude that the difference in the RMWs of delaying pension take-up for the wife and the husband is not a significant explanatory variable. The high p-value may be influenced by the low number of observations. In any case, we are unable to conclude that the difference in RMW has any explanatory power.

### The RMWs as Distinct Regressors

The dependent variable in the second model is a dummy variable which takes the value 1 if the wife claimed benefits while the husband did not. In the third regression the dependent variable is a dummy variable taking the value 1 if the husband claimed benefits while the wife did not. I use the RMW of delaying the pension take-up for the wife and the husband as two distinct regressors, and I estimate the models using the whole sample ( $N = 404$ ).

Let  $P(C_W = 1 \cap C_H = 0)$  denote the probability that the wife claimed pension benefits while the husband did not claim. Similarly, let  $P(C_W = 0 \cap C_H = 1)$  denote the probability that the wife did not claim benefits while the husband

claimed. If the couple is concerned with maximizing lifetime income, we expect that  $P(C_W = 1 \cap C_H = 0)$  depends negatively on  $RMW_W$  and positively on  $RMW_H$ . Conversely we expect that  $P(C_W = 0 \cap C_H = 1)$  depends positively on  $RMW_W$  and negatively on  $RMW_H$ .

*The Probability of Wife Claiming and Husband not Claiming*

The estimated probability of the wife claiming and the husband not claiming is:

$$\hat{P}_i(C_W = 1 \cap C_H = 0) = 2.157 - 1.127 \cdot RMW_{(W)i} - 0.843 \cdot RMW_{(H)i} \quad (27)$$

While the coefficient of  $RMW_W$  has the expected sign, the coefficient of  $RMW_H$  has the opposite sign of what we would expect. None of the coefficients are, however, significant at any relevant level. In addition, the p-value of the model's overall significance is 0.3142, meaning that we would not reject the null hypothesis that all coefficients are zero at any relevant level of significance.

*The Probability of Husband Claiming and Wife not Claiming*

The estimated probability of the husband claiming while the wife did not is:

$$\hat{P}_i(C_W = 0 \cap C_H = 1) = 4.255 - 0.572 \cdot RMW_{(W)i} - 3.355 \cdot RMW_{(H)i} \quad (28)$$

While the coefficient of  $RMW_H$  has the expected sign, the coefficient of  $RMW_W$  has the opposite sign of what we would expect.  $RMW_H$  is significant, and the reported p-value of the estimated coefficient is 0.018.  $RMW_W$  is not significant. The p-value of the model's overall significance is 0.0433, so we reject the null hypothesis that all coefficients are zero at  $\alpha = 0.05$ .

## **Disregarding the Partner's Take-Up Decision**

The empirical evidence presented does not suggest that Norwegian couples coordinate on claiming pension benefits. A possible explanation is that the couples do not cooperate, like for example the non-cooperative model predicts. A second possible explanation is that the individuals do not understand the incentives in the pension scheme.

The findings of Brinch et al. (2013) suggests that the Norwegian pension scheme is plagued by adverse selection, and that the individuals respond to the incentives built into the pension scheme. I run two regressions on the sample I have studied ( $N = 404$ ), to investigate if the individuals behave in accordance



with the findings of Brinch et al. (2013).

#### *The Probability of the Wife Claiming Benefits*

First I investigate whether the women in the sample respond to the incentives in the pension scheme. I estimate the probability of a wife claiming pension benefits, regardless of what her husband did, using observations on the sample of 404 couples where both members were born in 1949 and eligible for early pension take-up in 2011. To be able to compare the results with the regressions in the previous section, I use the RMW of delaying pension take-up of both members as regressors. The estimated result is the following:

$$\hat{P}_i(C_W = 1) = 7.856 - 5.433 \cdot RMW_{W(i)} - 1.768 \cdot RMW_{H(i)} \quad (29)$$

The p-value associated with the model's overall significance is 0.0003, so we reject the null hypothesis that all coefficients are zero with high confidence.  $RMW_{(W)}$  is significant at  $\alpha = 0.001$ , and the estimated coefficient has the expected sign. An increase in the RMW of delaying the wife's pension take-up of, say 0.01, reduces the probability that the wife claimed benefits by 5.4 percentage points. This is in accordance with the findings of Brinch et al. (2013).  $RMW_{(H)}$  is not significant at any relevant level.

#### *The Probability of the Husband Claiming Benefits*

I investigate whether the men in the sample respond to the incentives in the pension scheme. I estimate the probability of the husband claiming pension benefits, regardless of what his wife did. The estimated result is the following:

$$\hat{P}_i(C_H = 1) = 9.954 - 4.877 \cdot RMW_{(W)i} - 4.280 \cdot RMW_{(H)i} \quad (30)$$

The p-value associated with the model's overall significance is 0.0002, so we reject the null hypothesis that all coefficients are zero with high confidence.  $RMW_{(H)}$  is significant at  $\alpha = 0.05$ , and the estimated coefficient has the expected sign. An increase in the RMW of delaying the husband's pension take-up of, say 0.01, reduces the probability that the husband claimed benefits by 4.3 percentage points. This is in accordance with the findings of Brinch et al. (2013). A puzzling result is, however, that  $RMW_{(W)}$  is significant as well. An increase in the RMW of delaying the wife's pension take-up of, say 0.01, reduces the probability that the

husband claimed benefits by 4.8 percentage points. The coefficient is significant at a  $\alpha = 0.01$ . This rather puzzling result will be further discussed below.

### Some Remarks

The probability of the wife claiming pension benefits is the sum of the following:

$$\underbrace{P(C_W = 1)}_{(29)} = \underbrace{P(C_W = 1 \cap C_H = 1)}_{(B)} + \underbrace{P(C_W = 1 \cap C_H = 0)}_{(27)} \quad (31)$$

In the regression where I estimated the probability that the wife claimed benefits while the husband did not claim benefits (27), none of the coefficients were significant at any relevant level and we would not reject the joint hypothesis the all coefficients are zero. We know, however, that the RMW of the wife's take-up is a significant determinant of the probability of the wife claiming pension benefits. This means that the RMW of delaying the wife's pension take-up is an important determinant of the probability of both members claiming benefits. Similarly, since the RMW of delaying husband's take-up is not significant with regard to the probability of the wife claiming pension benefits, we conclude that the RMW of delaying husband's take-up is not significant with regard to the probability of both members claiming pension benefits.

Similarly, the probability of the husband claiming pension benefits is given by:

$$\underbrace{P(C_H = 1)}_{(30)} = \underbrace{P(C_W = 1 \cap C_H = 1)}_{(B)} + \underbrace{P(C_W = 0 \cap C_H = 1)}_{(28)} \quad (32)$$

We know that both the RMW of delaying the wife's take-up and the RMW of delaying the husband's take-up are determinants of the probability of the husband claiming benefits. I argued above that the RMW of delaying the wife's pension take-up is an important determinant of the probability that both members claim pension benefits. The effect of the RMW of delaying the wife's take-up on the probability of the husband claiming benefits, is thus captured by the probability that both members claim their benefits (B). I also argued that the RMW of delaying husband's take-up was not significant with regard to the probability that both members claim their benefits. This means that the effect of the RMW of delaying husband's take-up on the probability that the husband claimed benefits, is captured entirely by the probability that the husband claimed benefits while

the wife did not claim benefits (28).

### **Summarizing the Results of this Section**

The results in this section can be summarized as follows:

- The difference in relative money's worth between delaying the wife's take-up and the husband's take-up is not a significant determinant of the probability that the wife claimed pension benefits, while the husband did not
- The RMW of delaying the wife's take-up is an important determinant of the probability that the wife delayed pension take-up. In particular, this variable affects the probability of the wife claiming benefits through the probability that both members claimed their pension benefits.
- The RMW of delaying the husband's take-up is an important determinant of the probability that the husband delayed pension take-up. In particular, this variable affects the probability of the husband claiming benefits through the probability that the husband claimed while the wife did not claim pension benefits.

There is no intuitive explanation of why the RMW of delaying the wife's pension take-up is an important determinant of the probability of both members claiming benefits, while the RMW of delaying the husband's take up is insignificant with respect to this probability. Since the sample is relatively small, this result may be a coincidence. Another possible explanation is that there are peer effects, i.e., that the members of the couple simply do the same thing. It should be emphasized that this section does not consider the retirement decision. Since the take-up decision and the retirement decision may be simultaneous decisions, there may be effects at work which this analysis does not capture.

## 5.4 Some Concluding Remarks

The empirical evidence presented in this chapter suggests the following conclusions about Norwegian couples and their pension take-up:

- Own income is an important determinant when deciding to retire without claiming pension benefits. In particular, as an individual moves from the third to the upper quartile of the income distribution in the sample, the probability of retiring without claiming pension benefits increases with 3.7 percentage points.
- Partner's income does not affect the decision to retire without claiming pension benefits.
- For couples in which both members were born in 1949 and eligible for early pension take-up and in which only one of the members claimed pension benefits, the difference in the RMWs between delaying the wife's take-up and the husband's take-up is not a significant determinant of the probability that the wife claimed pension benefits, while the husband did not.
- Empirical evidence indicates that the individuals in the sample understand the incentive structure in the pension scheme and that individuals take their expected longevity into account when deciding whether or not to claim pension benefits. These findings are in accordance with the findings of Brinch et al. (2013): individuals with higher than average expected longevity are more prone to delay pension take-up than individuals with lower expected longevity

The economic models of household behaviour makes different predictions with regard to couples' pension take-up. In particular, the unitary model and the collective model predict that the couple will coordinate on the claiming of pension benefits. These predictions are not confirmed by the empirical findings.

The predictions of the cooperative bargaining model is less clear, as maximization of household income produces two opposing effects. Maximization of household income makes the pool to be divided bigger, which is an argument in favour of cooperation. The increased stream of future pension benefits may, however, alter the bargaining power.

The empirical findings appear to be in accordance with the non-cooperative model. According to the non-cooperative model, the couples will as a general rule

not cooperate on their pension take-up.<sup>50</sup> An objection could be that couples do not understand the incentives in the pension scheme. However, empirical evidence suggests that the individuals understand the incentives very well. In particular, expected longevity is a significant determinant of individuals' pension take-up decisions, suggesting that individuals are concerned with maximizing their own income.

It should be emphasized that both empirical strategies have potential weaknesses. In the first section I estimate two linear probability models. In the first regression I estimate the probability of retiring without claiming pension benefits. The disadvantage of this analysis, is that the individuals face four different combinations of retirement and take-up. Since the decision to retire and the decision to claim pension benefits may be simultaneous decisions, opposing effects may be at work. In the second regression I exclude the non-retired individuals, and estimate the probability of not claiming. Since the retirement decision and the take-up decision may be simultaneous decisions, the problem with this approach is that the sample may be self-selected. It should also be emphasized that by evaluating retirement in terms of reduced income, it is possible that individuals who retired partially are defined as retired.

In the second section I investigate the take-up of pension benefits by couples where both members were born in 1949 and eligible for pension take-up in 2011. The sample is a rather small, and the retirement decision is disregarded. Since the retirement decision and the take-up decision may be simultaneous decisions there may be effects at work which this analysis does not capture.

---

<sup>50</sup>In chapter 4 I argued that there are some cases in which the prediction of the non-cooperative model is that being in a couple may facilitate delaying pension take-up. For this to be the case, the partner's income must be sufficiently high, and both persons must sufficiently favour the public goods.

## 6 Conclusion

This thesis has investigated whether empirical evidence suggests that Norwegian couples coordinate on claiming pension benefits. The empirical evidence presented in this thesis suggests that they do not.

A key feature of the new Norwegian pension scheme is flexible retirement for the age group 62 - 75 years, implying that the decision to retire from the labour force and the decision to claim pension benefits are decoupled. An individual who is eligible to claim pension benefits when she turns 62 may claim benefits right away or delay claiming by, say, a year. The delay of claiming will increase her annual pension benefits for the rest of her life, but pension benefits this year are forfeited. The Norwegian pension scheme is actuarial neutral on average, meaning that, for a given pension wealth, the expected discounted value of future benefits is the same regardless of the timing of pension take-up for agents with average expected longevity. For agents whose life expectancy differs from the average, on the other hand, the expected discounted value of future pension benefits depends on the timing of the pension take-up. These features of the new Norwegian pension scheme were discussed in chapter 2.

Delaying the take-up of pension benefits implies that pension benefits this year are forfeited, but annual pension benefits will be higher for the rest of an agent's life. This means that delaying pension take-up is equivalent to buying an annuity, treating the pension benefits forfeited as the price of the annuity. The take-up decision can therefore be studied in the theoretical framework normally used to study demand for annuities. In chapter 3 I discussed some determinants of annuity demand, including the money's worth, risk aversion, pre-annuitized wealth, credit market and liquidity constraints, the subjective discount factor, marital status and bequest motives. I argued that the money's worth of the annuity and risk aversion, in particular, are important determinants of annuity demand. The money's worth of an annuity is increasing in the expected longevity, meaning that annuities are worth more to individuals who expect to live longer. The markets for annuities - including the new Norwegian pension scheme - are therefore potentially exposed to problems of adverse selection. An annuity provides insurance against the risk of outliving one's resources. This means that more risk aversion leads to a higher valuation of the annuity. This second factor may be less important in the context of the Norwegian pension scheme since all members of the National Insurance Scheme are guaranteed a

minimum pension and therefore partially isolated against the risk of outliving their resources.

When the new pension scheme was implemented in 2011, all four combinations of retirement and claiming turned out to be rather common. Brinch et al. (2013) find some positive correlation between retirement and the claiming of old age pensions, but the relationship is far from perfect. In particular, the authors find that claiming is strongly associated with predictors of expected longevity, suggesting that there is substantial adverse selection with regard to the claiming of pension benefits in the new Norwegian pension scheme.

With regard to the four different combinations of retirement and claiming, retiring without claiming pension benefits may not be feasible for some agents due to liquidity constraints. Being in a couple may facilitate delaying take-up while retired if the agent can rely on his or her partner's income. Economic models of the household differ, however, in the predictions of economic cooperation and household money management. In chapter 4, four different models of household behaviour were presented as well as their predictions with regard to cooperation on pension take-up. According to the unitary model the household will indeed cooperate to maximize expected household income. This model rests on the assumption that the household maximizes a household utility function subject to the household budget constraint. The prediction of the collective model was the same. The underlying assumptions in the collective model differ, however, from the assumptions in the unitary model. In the collective model the individuals have distinct preferences but will reach a Pareto-efficient agreement since they can make binding and enforceable contracts. According to the non-cooperative model being in a couple will only by exception facilitate delaying pension take-up if an agent is liquidity-constrained. The predictions of the cooperative bargaining model that was introduced were less clear.

The starting point for the empirical investigation of couples' take-up decisions were all Norwegian citizens born in 1949, members of a couple and eligible for early pension take-up in 2011. For these individuals I have data on annual incomes (2010 and 2011), wealth (2010), partner's income (2010) and pension take-up. I also have data on what Brinch et al. (2013) call the relative money's worth (RMW) of delaying pension take-up from age 62 to 67. In their study of adverse selection in the Norwegian pension scheme, Brinch et al. (2013) estimate a mortality model and simulate the life span of each individual in the 1949-cohort. The authors use the expected longevity to calculate the RMW of delaying pension

take-up for each individual who was eligible for early pension take-up in 2011. The RMW is defined as the lifetime expected benefits conditional on claiming at age 67 in terms of expected benefits conditional on claiming at age 62.

The first empirical strategy was to investigate the decision to retire without claiming pension benefits. First, I estimated a linear probability model where the dependent variable was a dummy variable taking the value 1 if the individual retired without claiming pension benefits. I used own income and wealth, partner's income and the RMW of delaying pension take-up as regressors. The only significant regressor was a dummy variable indicating whether the individual was in the upper quartile of the income distribution in the sample. Importantly, wealth, partner's income and the RMW of delaying pension take-up were not significant. In the second step, I excluded individuals who did not retire from the sample, and used the same regressors to estimate the probability of not claiming pension benefits. Three regressors were significant: a dummy variable indicating whether the individual was in the upper quartile of the income distribution, a dummy variable indicating whether the individual was in the upper quartile of the wealth distribution and the RMW of delaying pension take-up. Partner's income was not significant. It is tempting to interpret the estimated result as the probability of not claiming benefits given that an individual has retired. Since the decision to retire and the decision to claim pension benefits may be simultaneous decisions, the estimated result should, however, be interpreted with caution.

The second empirical strategy was to investigate couples where both members of the couple were born in 1949 and eligible for early pension take-up in 2011. First, I estimated the probability that the wife claimed while the husband did not claim benefits, using data on couples in which only one member claimed benefits. The sole regressor was the difference in RMW, and this regressor was not significant. Thereafter I estimated the probability of the wife claiming while the husband did not claim, using the RMW of delaying the take-up of both the wife and the husband as distinct regressors. None of the regressors were significant, and we would not reject the null hypothesis that all coefficients were zero. Similarly, I estimated the probability of husband claiming while the wife did not claim, using the RMW of delaying the take-up of both the wife and the husband as distinct regressors. In this regression the RMW of delaying the husband's take-up was significant.

At last, I investigated whether empirical evidence suggests that individuals in the sample understand the incentives in the pension scheme. I estimated the



probability of the wife claiming benefits, disregarding the husband's decision. I used the RMW of delaying the take-up of both the wife and the husband as distinct regressors, and found that only the RMW of delaying the wife's take-up was significant. I ran a similar regression estimating the probability of the husband claiming pension benefits, regardless of what his wife did, and found that both regressors were significant. The findings suggest that claiming is strongly associated with the RMW of delaying pension take-up, and are thus in accordance with the findings of Brinch et al. (2013).

None of the empirical findings presented suggest that Norwegian couples coordinate on claiming pension benefits. Empirical evidence suggests, however, that the individuals understand and respond to the incentives in the pension scheme. Lack of cooperation should therefore not be interpreted as a lack of understanding of the incentive structure. These findings are in accordance with the predictions of the non-cooperative model. The findings may also be in accordance with the cooperative bargaining model, suggesting for example that it is important to control own income.

## References

- Akerlof, G. A. (1970). The Market for 'Lemons': Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics* 84(3), 488–500.
- Apps, P. and R. Rees (2007). Household Models: An Historical Perspective. CESifo Working Paper Series No. 2172, CESifo.
- Arbeids- og velferdsdirektoratet (2011). Rundskriv: Uttak av alderspensjon. Available at <http://www.nav.no/rettskildene/Rundskriv/%C2%A7+19-10+Uttak+av+alderspensjon.147741.cms>.
- Arbeids- og velferdsdirektoratet (2013a). Forholdstall og delingstall. Available at <http://www.nav.no/Pensjon/231194.cms>.
- Arbeids- og velferdsdirektoratet (2013b). Ytelser til gjenlevende ektefelle. Available at <http://www.nav.no/Pensjon/Ytelser+ved+d%C3%B8dsfall/Ytelser+til+gjenlevende+ektefelle>.
- Arbeidsdepartementet (2009). Om lov om endringer i folketrygdloven (ny alderspensjon). Ot.prp. nr. 37, 2008-2009. Available at: <http://www.regjeringen.no/nb/dep/ad/dok/regpubl/otprp/2008-2009/otprp-nr-37-2008-2009-.html?id=545925>.
- Becker, G. (1991). *A Treatise on the Family*. Harvard University Press.
- Becker, G. S. (1974, Nov.-Dec.). A theory of social interactions. *Journal of Political Economy* 82(6), 1063–93.
- Bernheim, B. D. (1991). How Strong Are Bequest Motives? Evidence Based on Estimates of the Demand for Life Insurance and Annuities. *Journal of Political Economy* 99(5), 899–927.
- Bourguignon, F., M. Browning, P.-A. Chiappori, and V. Lechene (1993). Intra Household Allocation of Consumption: A Model and Some Evidence from French Data. *Annales d'Economie et de Statistique* 29, 137–156.
- Brinch, C., D. Fredriksen, and O. L. Vestad (2013). Adverse Selection in a Mandatory Public Pension Scheme. *Unpublished manuscript*.
- Brown, J. R. (2001). Private Pensions, Mortality Risk, and the Decision to Annuitize. *Journal of Public Economics* 82(1), 29–62.

- Browning, M., P. Chiappori, and Y. Weiss (2011). Family economics. Tel Aviv University, unpublished textbook manuscript. Available at [http://www.tau.ac.il/~weiss/fam\\_econ/BCW\\_Book\\_index\\_07\\_09\\_2011\\_MB.pdf](http://www.tau.ac.il/~weiss/fam_econ/BCW_Book_index_07_09_2011_MB.pdf).
- Browning, M. and P.-A. Chiappori (1998). Efficient Intra-Household Allocations: A General Characterization and Empirical Tests. *Econometrica* 66(6), 1241–1278.
- Browning, M. and T. F. Crossley (2001). The Life-Cycle Model of Consumption and Saving. *Journal of Economic Perspectives* 15(3), 3–22.
- Browning, M. and V. Lechene (2001). Caring and Sharing: Tests Between Alternative Models of Intra-Household Allocation. Discussion Papers 01-07, University of Copenhagen. Department of Economics.
- Bütikofer, A., M. Gerfin, and G. Wanzenried (2009). Income Pooling and the Distribution of Individual Consumption among Couples in Switzerland. IFZ Working Paper No 12/2009.
- Cannon, E. and I. Tonks (2008). *Annuity Markets*. Oxford: Oxford University Press.
- Chiappori, P.-A. and O. Donni (2009). Non-Unitary Models of Household Behavior: A Survey of the Literature. IZA Discussion Papers 4603, Institute for the Study of Labor (IZA).
- Chiappori, P.-A., L. Haddad, J. Hoddinott, and R. Kanbur (1993). Unitary versus Collective Models of the Household : Time to Shift the Burden of Proof? Policy Research Working Paper Series 1217, The World Bank.
- Chiappori, P.-A. and B. Salanie (2000). Testing for Asymmetric Information in Insurance Markets. *Journal of Political Economy* 108(1), 56–78.
- Coile, C., P. Diamond, J. Gruber, and A. Jousten (2002). Delays in Claiming Social Security Benefits. *Journal of Public Economics* 84(3), 357–385.
- Cowell, F. A. (2005). *Microeconomics: Principles and Analysis*. New York: Oxford University Press Inc.
- Davidoff, T., J. R. Brown, and P. A. Diamond (2005). Annuities and Individual Welfare. *American Economic Review* 95(5), 1573–1590.

- Davies, J. B. and P. Kuhn (1992). Social Security, Longevity, and Moral Hazard. *Journal of Public Economics* 49(1), 91–106.
- Dushi, I. and A. Webb (2004). Household Annuitization Decisions: Simulations and Empirical Analysis. *Journal of Pension Economics and Finance* 3(2), 109–143.
- Ermisch, J. F. (2003). *An Economic Analysis of the Family*. Princeton: Princeton University Press.
- Finkelstein, A. and J. Poterba (2004). Adverse Selection in Insurance Markets: Policyholder Evidence from the UK Annuity Market. *Journal of Political Economy* 112(1), 183–208.
- Halvorsen, E. (2011). Norske husholdningers sparing. *Økonomiske analyser* 3, 32–35.
- Henriques, A. (2012). How does Social Security Claiming Respond to Incentives? Considering Husbands’ and Wives’ Benefits Separately. Finance and Economics Discussion Series No. 2012-19, Division of Research & Statistics and Monetary Affairs, Federal Reserve Board.
- Hurd, M. D. and K. McGarry (1995). Evaluation of the Subjective Probabilities of Survival in the Health and Retirement Study. *The Journal of Human Resources* 30, S268–S292. Special Issue on the Health and Retirement Study: Data Quality and Early Results.
- Hurd, M. D., J. P. Smith, and J. M. Zissimopoulos (2004). The Effects of Subjective Survival on Retirement and Social Security Claiming. *Journal of Applied Econometrics* 19(6), 761–775.
- Indahl, B. (2012). Er det lønnsomt å ta ut tidlig pensjon? *Samfunnsøkonomen* 2.
- Jaffee, D. and J. E. Stiglitz (1990). Credit Rationing. In B. M. Friedman and F. H. Hahn (Eds.), *Handbook of Monetary Economics* (1 ed.), Volume 2, Chapter 16, pp. 837–888. Elsevier.
- Jousten, A. (2007). Public Pension Reform: A Primer. IMF Working Paper WP/07/28, International Monetary Fund.
- Kotlikoff, L. J. and A. Spivak (1981). The Family as an Incomplete Annuities Market. *Journal of Political Economy* 89(2), 372–91.

- Lockwood, L. (2012). Bequest Motives and the Annuity Puzzle. *Review of Economic Dynamics* 15(2), 226–243.
- Lundberg, S., R. Pollak, and T. Wales (1997). Do Husbands and Wives Pool their Resources? Evidence from the United Kingdom Child Benefit. *Journal of Human Resources* 32(3), 463–480.
- Lundberg, S. and R. A. Pollak (1993). Separate Spheres Bargaining and the Marriage Market. *Journal of Political Economy* 101(6), 988–1010.
- Lundberg, S. and R. A. Pollak (1994). Noncooperative Bargaining Models of Marriage. *American Economic Review* 84(2), 132–37.
- Lundberg, S. and R. A. Pollak (1996). Bargaining and Distribution in Marriage. *The Journal of Economic Perspectives* 10(4), 139–158.
- McElroy, M. B. (1990). The Empirical Content of Nash-Bargained Household Behavior. *Journal of Human Resources* 25(4), 559–583.
- Munnell, A. H. and M. Soto (2005). Why Do Women Claim Social Security Benefits So Early? Briefs 35, Center for Retirement Research, Boston College.
- Philipson, T. J. and G. S. Becker (1998). Old-Age Longevity and Mortality-Contingent Claims. *Journal of Political Economy* 106(3), 551–573.
- Phipps, S. and P. Burton (1998). What’s Mine Is Yours? The Influence of Male and Female Incomes on Patterns of Household Expenditure. *Economica* 65(260), 599–613.
- Pollak, R. (2003). Gary Becker’s Contributions to Family and Household Economics. *Review of Economics of the Household* 1(1), 111–141.
- Queisser, M. and E. Whitehouse (2006). Neutral or Fair? Actuarial Concepts and Pension-System Design. OECD Social, Employment and Migration Working Papers No. 40, OECD Publishing.
- Rothschild, C. G. (2009). Adverse Selection in Annuity Markets: Evidence from the British Life Annuity Act of 1808. *Journal of Public Economics* 93(5-6), 776–784.
- Rothschild, M. and J. E. Stiglitz (1976). Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information. *The Quarterly Journal of Economics* 90(4), 630–49.

- Samuelson, P. A. (1956). Social Indifference Curves. *The Quarterly Journal of Economics* 70(1), 1–22.
- Sass, S. A., W. Sun, and A. Webb (2007). Why Do Married Men Claim Social Security Benefits So Early? Ignorance or Caddishness? Working Papers 2007-17, Center for Retirement Research, Boston College.
- Sheshinski, E. (2008). *The Economic Theory of Annuities*. Princeton: Princeton University Press.
- Stortingsmelding nr. 12 2004 - 2005 (2004). Pensjonsreform - trygghet for pensjonene. Available at <http://www.regjeringen.no/Rpub/STM/20042005/012/PDFS/STM200420050012000DDDPDFS.pdf>.
- Thomas, D. (1990). Intra-Household Resource Allocation: An Inferential Approach. *Journal of Human Resources* 25(4), 635–664.
- Varian, H. (1992). *Microeconomic analysis*, Volume 2. Norton New York.
- Varian, H. R. (2006). *Intermediate Microeconomics: A Modern Approach* (7th ed.). New York: W. W. Norton & Company.
- Yaari, M. E. (1965). Uncertain Lifetime, Life Insurance, and the Theory of the Consumer. *The Review of Economic Studies* 32(2), 137–150.

# Appendices

## A Mathematical Calculations

### Solving the non-cooperative model

Person  $a$  solves the following maximization problem:

$$\mathcal{L} = \alpha \ln(q^a) + (1 - \alpha) \ln(Q^a + Q^b) - \lambda(pq^a + PQ^a - Y^a) \quad (33)$$

The choice-variables are  $q^a$  and  $Q^a$ , and the first-order conditions are:

$$\frac{\alpha}{q^a} - \lambda p = 0 \quad (34)$$

$$\frac{1 - \alpha}{Q^a + Q^b} - \lambda P = 0 \quad (35)$$

Combining the two first-order conditions we get an expression that we can solve for  $q^a$ :

$$\begin{aligned} \frac{\alpha}{q^a p} = \frac{1 - \alpha}{P(Q^a + Q^b)} &\Leftrightarrow q^a p(1 - \alpha) = \alpha P(Q^a + Q^b) \\ &\Leftrightarrow q^a = \frac{\alpha P(Q^a + Q^b)}{p(1 - \alpha)} \end{aligned} \quad (36)$$

By inserting (36) in person  $a$ 's budget constraint,  $p \cdot q^a + P \cdot Q^a = Y^a$ , we find  $a$ 's demand for the public good:

$$\begin{aligned} p \cdot \left( \frac{\alpha P(Q^a + Q^b)}{p(1 - \alpha)} \right) + P \cdot Q^a &= Y^a \\ \Leftrightarrow \alpha P(Q^a + Q^b) + (1 - \alpha)(P \cdot Q^a) &= Y^a(1 - \alpha) \\ \Leftrightarrow \alpha P Q^b + P Q^a &= (1 - \alpha) Y^a \\ \Leftrightarrow Q^a &= \frac{(1 - \alpha) Y^a}{P} - \alpha Q^b \end{aligned} \quad (37)$$

We note that,

$$\begin{aligned}
\frac{\partial Q^a}{\partial \alpha} &= -\frac{Y^a}{P} - Q^b < 0 \\
\frac{\partial Q^a}{\partial Y^a} &= \frac{1 - \alpha}{P} > 0 \\
\frac{\partial Q^a}{\partial P} &= -\frac{(1 - \alpha)Y^a}{P^2} < 0 \\
\frac{\partial Q^a}{\partial Q^b} &= -\alpha < 0
\end{aligned} \tag{38}$$

Person  $a$ 's demand for the public good increases with income and decreases with the price of the public good. Furthermore, it decreases with person  $b$ 's contribution to the public good and with the parameter  $\alpha$ , measuring the relative weight person  $a$  puts on the private good.

Similarly, person  $b$  solves the following maximization problem:

$$\mathcal{L} = \beta \ln(q^b) + (1 - \beta) \ln(Q^a + Q^b) - \lambda(pq^b + PQ^b - Y^b) \tag{39}$$

This program is solved precisely in the same manner as the program for person  $a$ . Person  $b$ 's demand for the public good satisfies the same properties as person  $a$ 's demand:

$$Q^b = \frac{(1 - \beta)Y^b}{P} - \beta Q^a \tag{40}$$



## B Retiring Without Claiming Pension Benefits

Table 8 reports the regression results from Stata when I estimated the probability of retiring and not claiming, using data on 8 458 individuals.

Table 8: The probability of retiring without claiming pension benefits

	(1) retired_and_notclaiming
labour_income_2	-0.00614 (0.00906)
labour_income_3	-0.0104 (0.00905)
labour_income_4	0.0371*** (0.00909)
wealth_2	0.00828 (0.00905)
wealth_3	0.00202 (0.00909)
wealth_4	0.0165 (0.00916)
partner_labour_income_2	0.00144 (0.00905)
partner_labour_income_3	0.000248 (0.00905)
partner_labour_income_4	-0.00390 (0.00931)
rmw	-0.00859 (0.164)
<i>N</i>	8458

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## C F-test

To test whether income is a significant variable, I test the joint hypothesis:

$$H_0 : \alpha_1 = \alpha_2 = \alpha_3 = 0$$

against the alternative hypothesis:

$$H_1 : \text{At least one of the coefficients are non-zero.}$$

When the null-hypothesis is true, income drop out as an explanatory variable. The F-test for the hypothesis  $H_0 : \alpha_1 = \alpha_2 = \alpha_3 = 0$  is based on a comparison of the sums of squared errors from the unrestricted model in (25) and the restricted model where income is dropped as explanatory variable.

The test-statistic is:

$$F = \frac{\frac{SSE_R - SSE_U}{J}}{\frac{SSE_U}{N-K}}$$

where  $SSE_R$  is the sum of squared errors in the restricted model,  $SSE_U$  is the sum of squared errors in the unrestricted model,  $J$  = the number of restrictions in the null-hypothesis,  $N$  = is the number of observations, and  $K$  = is the number of coefficients in the unrestricted model. If  $H_0$  is true, then the  $F$ -statistic follows an F-distribution with  $(J, N - K)$  degrees of freedom.

Since  $J = 3$ ,  $N = 8458$  and  $K = 11$ , the F-statistic follows a  $F_{(3, 8447)}$ -distribution when the null hypothesis is true. Using  $\alpha = 0.05$ , the critical value from the  $F_{(3, 8447)}$ -distribution is  $F_C = 2.605$ . We reject  $H_0$  if  $F \geq 2.605$ .<sup>51</sup>

The observed  $F$ -statistic is

$$F_{(OBS)} = \frac{\frac{729.6 - 728.6}{3}}{\frac{728.6}{8458 - 11}} \approx 3.864 \geq F_C$$

We therefore reject the null-hypothesis that all coefficients are zero, and conclude that at least one of the coefficients are non-zero.

---

<sup>51</sup>If the null hypothesis is not true, then the difference between  $SSE_R$  and  $SSE_U$  becomes large, implying that the restrictions placed on the model by the null hypothesis significantly reduces the ability of the model to fit the data.

## D Regression on a restricted sample

Table 9 reports the regression results from Stata when I estimated the probability of delaying the take-up of benefits, using data on a subsample of 2 336 individuals.

Table 9: The probability of not claiming benefits, using data on individuals in the sample who did retire in 2011.

	(1) retired_and_notclaiming
labour_income_2	0.0179 (0.0304)
labour_income_3	-0.00718 (0.0324)
labour_income_4	0.130*** (0.0326)
wealth_2	0.0401 (0.0312)
wealth_3	-0.00117 (0.0314)
wealth_4	0.0638* (0.0321)
partner_labour_income_2	0.0233 (0.0306)
partner_labour_income_3	0.0188 (0.0310)
partner_labour_income_4	-0.00158 (0.0333)
rmw	2.001*** (0.595)
_cons	-1.762** (0.613)
<i>N</i>	1936

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## E Both Members of the Couple from the 1949-cohort

Table 10: The probability that the wife claimed while the husband did not claim, using difference in RMWs as regressor.

	(1)
	wife_claim_husband_not
diff_RM_W	-2.613 (3.197)
_cons	0.409** (0.144)
<i>N</i>	94
Standard errors in parentheses	
* $p < 0.05$ , ** $p < 0.01$ , *** $p < 0.001$	

Table 11: The probability that the wife claimed while the husband did not claim, using the RMWs as distinct regressors.

	(1)
	wife_claim_husband_not
RMW_W	-1.127 (0.998)
RMW_H	-0.843 (0.843)
_cons	2.157 (1.378)
<i>N</i>	404
Standard errors in parentheses	
* $p < 0.05$ , ** $p < 0.01$ , *** $p < 0.001$	

Table 12: The probability that the husband claimed while the wife did not claim, using the RMWs as distinct regressors.

	(1)
	husband_claim_wife_not
RMW_W	-0.572 (1.403)
RMW_H	-3.355* (1.403)
_cons	4.255* (1.984)
<i>N</i>	404

Standard errors in parentheses  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table 13: The probability that the wife claimed, regardless of what her husband did, using the RMWs as distinct regressors.

	(1)
	wife_claim
RMW_H	-1.768 (1.419)
RMW_W	-5.433*** (1.526)
_cons	7.856*** (1.996)
<i>N</i>	404

Standard errors in parentheses  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table 14: Husband claim regardless of wife. RMW of both as regressor

	(1)
	husband_claim
RMW_H	-4.280* (1.662)
RMW_W	-4.877** (1.788)
_cons	9.954*** (2.338)
<i>N</i>	404
Standard errors in parentheses	
* $p < 0.05$ , ** $p < 0.01$ , *** $p < 0.001$	